SKILLS DEVELOPMENT PLAN

for
HISTORICAL ARCHITECTS
in the
NATIONAL PARK SERVICE

Cover: Detail of Original Shingle Siding, David Ogden House, Fairfield, Connecticut
Photograph by Jack E. Boucher, for the Historic American Buildings Survey, from the collection of the Prints and Photographs Division, Library of Congress.

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PREFACE

The National Park Service is committed to finding ways of achieving career-long growth for its employees. We need to view our staff as providing services for 20-30 years or more. In the face of that commitment, we, as managers, need to creatively use this Plan so that short term assignments such as 2 weeks or 6 weeks or 6 months can positively benefit the mission of the Service and lead to career growth for our historical architects. I see this Skills Development Plan as an important tool for historical architects in the Service to guide their own professional growth. The National Park Service is widely respected for the professionalism of its employees; such respect has to be re-earned by each new generation. We need to afford the newest generation this opportunity.

Beyond the uses of this Plan for Historical Architects, much of it could be used by Architectural Conservators and parts of it are applicable to preservation specialists, trades mechanics, maintenance workers and cultural resource management generalists. I also see it as a model -- I would like to see other disciplines develop such a compendium of skills and investigate the creative potential of the Service to assist our employees in developing their skills.

Opportunities abound for learning throughout the Service. I think we need to see them as opportunities that will continuously improve the quality of historic preservation in the National Park Service by building upon the already solid professionalism of its preservation specialists.

William Penn Mott, Jr.
Director

FOREWORD

An Historical Architect faces many challenges. It is never a simple task to gain understanding of a historic structure's physical evolution over time, to analyze its current problems, and then to devise an appropriate solution to best preserve historic materials--in spite of technical information or technical advice based on research and experience that is hard to locate. This Skills Development Plan seeks to become a catalyst to generate more sharing of technical information between historical architects. We have endeavored to identify what an historical architect could or should know; and we look to the historical architects to share their sources of information and the lessons they have learned from the historic structures they have worked on.

Building on the collective experience of the authors, and the excellent comments provided by the NPS historical architects on the May 1985 draft, we have developed a reference tool in planning further education in the field of historic architecture -- a Skills Development Plan. Since many historical architects remain both in the field of historic architecture and in the National Park Service for the length of a career -- perhaps 30 years -- the National Park Service has adopted this long-range Skills Development Plan. This is a "living" document that will be revised with usage in response to your comments and suggestions. There are three sections to this Plan.

The **Catalog of the Professional Skills Needed by Historical Architects** is a compilation of many of the major skills and areas of knowledge needed to work in historic architecture. This Catalog is not all inclusive or encyclopedic; rather it suggests the range and depth of knowledge needed by an historical architect to understand historic materials or historic building systems, or to recommend a preservation treatment. It is unlikely that any historic architect will possess all of these skills -- they are stated to create guide posts for learning more in this very broad field.

Selected Skills Needed by Historical Architects is a "short" list of basic skills selected from the Catalog and each of them is expanded to illustrate how the skill could be applied to a particular task; and also to suggest the depth and breadth of knowledge that can be attained. These "selected" skills convey information on how to begin, what is considered basic understanding, what could be a more advanced application of the skill, what it would take to have mastery of a subject, and what tasks each skill might enable you to do. These descriptions are followed by a list of some of the continuing education sources (if and where available) that offer training courses on aspects of the skill. An alternative to formal coursework is offered in the inclusion of a selected bibliography that includes both basic texts as well as some of the more advanced aspects of the skill. Neither the courses nor the bibliography is exhaustive; they are starting points. With these selected skills, a self-help program of independent study and training can be planned. The very absence of training or literature serves to suggest just how much still needs to be done in the way of communicating the lessons you have learned and are learning daily while working on cultural resources.

The last section, **Participation in the Skills Development Plan** provides information on the enrollment requirements which include developing a personal study plan, developing personal "projects" and preparing an annual assessment of participation.

The first two sections are seen as reference tools for career-long skills development. The third section provides a framework for participation.

The main instrument in this equation is you. Using this system, you should be able to:

--plan a self-help program

--participate in continuing education courses

--consult with senior level historical architects in the Service

--seek special project assignments

--cooperate and consult with architects in the private sector

--attend professional meetings and workshops offered by organizations like the APT and AIA

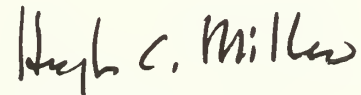
--share what you learn in Preservation Tech Notes, Feedback columns, Training Aids or slide lectures

--belong to local chapters of professional preservation organizations or specialized subject organizations like the Friends of Terra Cotta

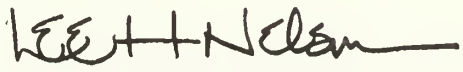
--review your progress at least once a year.

A special **Appendix A: NPS Intern-Architects Guide to Architectural Licensing** assists in the shorter-term career goal of architectural registration. Many architects see architectural licensing as an important, but difficult, career goal. Some architects in the Federal Government have had added difficulty in having their Federal work experience qualify towards meeting the licensing requirements. The National Council of Architectural Registration Boards (NCARB) has outlined the variety and length of experience it will accept as qualifying and, since many states accept NCARB standards, this section adapts NCARB's outline of experience and description of qualifying tasks to similar experience and tasks performed by historical architects in the NPS.

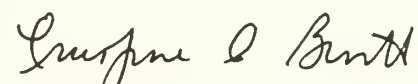
We invite comments and suggestions about this Plan. Please sent them to the Skills Development Plan Coordinator, c/o Preservation Assistance Division, National Park Service, P.O. Box 37127, Washington, D.C. 20013-7127.



Hugh C. Miller, AIA



Lee H. Nelson, FAIA



Emogene A. Bevitt

Catalog of the Professional Skills Needed by Historical Architects

Introduction

It goes without saying that an historical architect is first an architect and, as such, needs to be well grounded in all aspects of the architectural practice, including architectural design, planning, construction specifications and contract administration. This background, while essential, is still not sufficient to understand historic structures with their complex problems (weathering, patterns of use over time, neglect, etc.). Thus, in the Catalog that follows, the range and complexity of knowledge and skills needed by those who treat historic structures are described. At present, it is unlikely that any individual historical architect could lay claim to all of these skills. This Catalog is intended to be a reference tool to stimulate career-long development.

Knowledge of Preservation Philosophy, Policy, Standards, Architectural History, Design

Knowledge about the fundamental principles of historic preservation and architectural conservation.

Knowledge of American Architectural History and construction practices.

In-depth knowledge about the types of historic structures throughout American history including fortifications, industrial buildings, lighthouses, cemeteries, public buildings, domestic architecture, churches and missions, outdoor sculpture, vernacular architecture, historic engineering structures and industrial equipment, materials, processes and systems, to be able to deal with National Park Service structures as well as National Historic Landmarks and National Register-eligible structures.

Knowledge about the history of domestic buildings, urban and rural, with the various appurtenances to support family life, such as the arrangement as separate or connected outbuildings, back buildings, wells, privies, smokehouses, barns, stables, kitchens, springhouses, root cellars, etc.

Knowledge of historic designed landscapes, gardens, plantings including vistas, knowledge of vegetation and topography, knowledge of engineering in planning drainage and in planning pedestrial and vehicular circulation; knowledge of other landscape elements such as fencing, gates, walks, greenhouses, gazebos, bird houses, storm cellars, cemeteries; and knowledge of historic vernacular landscapes to be able to identify features, dates of changes, particular uses and time period; understanding how to record, preserve and maintain an historic landscape or historic vernacular landscape. Knowledge of historic landscape furnishings such as benches, lighting, sculpture, signage, and trash cans.

Knowledge about Legislative and Executive Order mandates, such as:
- --National Historic Preservation Act of 1966, as amended
- --Executive Order 11593
- --Code of Federal Regulations, 36 CRF, Parts 60, 61, 63, 65, 66, 67, 800
- --Antiquities Act of 1906
- --Historic Sites Act of 1935
- --Venice Charter

Knowledge of the Secretary of the Interior's Standards for Historic Preservation Projects and the Secretary of the Interior's Standards for Rehabilitation and Guidelines for Evaluating Historic Buildings. The ability to interpret and apply the Secretary's Standards and Guidelines to projects.

Knowledge about NPS Policy and Guidelines on:
- --National Park Service Management Policies and the Cultural Resources Management Guideline (NPS-28), including "Energy Conservation in Historic Structures and Structures Housing Collections"; "Design Compatibility in Historic Zones or Districts"; "Standards for Working Drawings and Specifications for Structure Treatment"; "Contracting for Structure Treatment";

"Contracting for Professional Services"; "Supervision of Historic Structure Treatment".
--Drafting Guideline for Design and Construction Drawing (NPS-10)
--Drawing and Map Numbers (NPS-29)
--Historic Property Leasing (NPS-38)
--National Register Programs Guideline (NPS-49)
--Loss Control Management Program (NPS-50)
--Implementation of Revised OMB Circular A-76 (Special Directive 80-5)
--Policy on Historic Property Leases and Exchanges (Special Directive 82-12)
--NPS Policy on Access for Disabled Persons (Special Directive 83-3); "Designing for Accessibility for Disabled Persons in Historic Structures and Sites" in the Architectural Barriers Act of 1968 as amended; 41 CFR 101-19, Uniform Federal Accessibility Standards; and the technical manual "Accommodation of Disabled Visitors at Historic Sites in the National Park System"
--NPS Safety and Occupational Health Management Policy (Special Directive 83-7); "Protection (Safety and Security) in Historic or Prehistoric Sites and Structures" and "Protective Systems for Structures" in the Department of the Interior Manual
--Implementation of Fire Safety Evaluation System to Provide Flexibility in Achieving Life Safety Equivalence (Staff Directive 84-12)
--Knowledge of the Standards for Managing Historic and Prehistoric Structures (Including Ruins), the Standards for Historic Rural Landscape Districts, and the Standards for Historical Ships and Boats
--NPS planning, programming and budget procedures
--preparation of budget documents
--task directives for work involving preservation
--procurement procedures for Architectural-Engineering (A-E) services
--preparation of nominations to the List of Classified Structures
--preparation of Historic Structure Reports
--preparation of Historic Structure Preservation Guides
--preparation of Resources Management Plans
--Cultural Resources Management Bibliography
--Historic Resource Study

Knowledge about the process, the preparation of forms, and the criteria for nominating structures and districts to the National Register of Historic Places.

Knowledge about related national issues affecting historic properties: energy conservation, handicapped access, life safety, fire and health codes and compliance; acid rain.

Knowledge of relevant organizations and information systems

Knowledge about the categories of park units within the park system and the historic preservation programs of the National Park Service including review of nominations to the National Register; development of National Historic Landmark nomination studies; review of rehabilitation projects for tax incentives; preparation of technical preservation publications; preparation of Historic Structure Reports, Historic Structure Preservation Guides and other technical documents; preparation of documentation to HABS/HAER standards for transmittal to the Library of Congress and other uses; knowledge about funding and fiscal planning needed to undertake preservation treatments in the Service.

Knowledge about National Historic Landmarks and the Landmark Programs (including cooperative agreements) and related activities growing out of the Historic Sites Act of 1935.

Knowledge about the role of the Advisory Council on Historic Preservation and the impact the Council has on park service properties especially in NPS compliance with the Section 106 process.

Knowledge about the preservation activities of Federal agencies such as the General Services Administration that own historic properties.

Knowledge about the role of State Historic Preservation Offices and local governments in the preservation of historic structures.

Knowledge about the programs of the National Trust for Historic Preservation.

Knowledge about the technical information generated by professional organizations such as:
-American Institute of Architects(AIA)
-American Institute for the Conservation of Historic and Artistic Works (AIC)
-American Society of Landscape Architects (ASLA)
-Association for Preservation Technology (APT)
-Art Deco Society
-Cooperative Preservation of Architectural Records (COPAR)
-Friends of Cast Iron
-Friends of Terra Cotta (FOTC)
-International Centre for the Study of the Restoration and Preservation of Cultural Property (ICCROM)
-International Council on Monuments and Sites (ICOMOS)
-International Institute for the Conservation of Artistic and Historic Works (IIC)
-National Building Museum
-Society of Architectural Historians (SAH)
-Society for the History of Technology (SHOT)
-Society for Industrial Archeology (SIA)
-Victorian Society of America (VSA)

Knowledge about the landmarks or heritage programs of the American Society of Civil Engineers, American Concrete Institute, and American Society of Mechanical Engineers.

Knowledge about the use of American Society for Testing Materials (ASTM) Standards for preservation work.

Knowledge about the materials and processes found in Sweet's Catalog File of Products for General Building and Renovation.

Knowledge about the building materials and building material functions described by the Construction Specifications Institute (CSI).

Knowledge about CSI formatting of maintenance information (being developed).

Knowledge about the building functions format in the Uniform Construction Index (UCI).

Knowledge about historic preservation degree programs and certificate programs offered by universities and other sources.

Knowledge about the services available from the Forest Products Laboratory for identification of wood species.

Knowledge of Historic Building Materials

Knowledge about wood as a historic building material; knowledge about wood's properties, performance, and limitations; knowledge about species of wood; knowledge about historic woodworking processes; knowledge about tools, "tool marks," and craftsmanship; knowledge about preservation treatments, repair and maintenance techniques that have become part of the historic fabric, for example, the kind of nails used, the way wood was glued or pieced in or dovetailed to distinguish later alterations and repairs may be used as dating "tools."

Knowledge about historic unit masonry materials such as brick, stone, terracotta; knowledge about the history of unit masonry materials -- their ingredients, composition and manufacture; knowledge about the variations in regional materials, sizes of units, color; knowledge about the impact of the craft processes and changes in technology over time that affected the size and quality of the products, for example, handmade bricks versus machine made bricks; knowledge about the great variety of stones used for American building construction; the types, their properties and characteristics including geological information; knowledge about the

history of the stone working industry; knowledge about the use of field stone versus cut stone; knowledge about the tools, craftsmanship and "tool marks" on walling; knowledge about bedding planes for stone and their importance in the integrity of the system.

Knowledge about concrete as a historic building material; its origins and early uses (as in Roman concrete); knowledge about the development of hydraulic limes and cements, including trass, pozzolona, and their early uses in America for unreinforced concrete, such as the "gravel wall" by Orson Fowler; knowledge about the development of reinforced concrete buildings, bridges, dams; knowledge about about architectural concrete with the various finishes such as exposed aggregates.

Knowledge about metals used in historic structures. Knowledge about the structural properties and uses of steel, cast iron, and wrought iron; knowledge about their uses as structural members as in tie rods, beams, trusses, skeletal construction, the development of their technology, e.g. hand forging, casting, rolling, and connecting devices; knowledge about the variety of metals used for roofing, flashing and exterior and interior decorative elements such as tin roofing, copper, lead, sheet iron; knowledge about the manufacture of these materials, their use as a function of size which was determined by limits in the manufacturing process; knowledge about the history of the fabrication of various metals including soldering, lap-seams, standing-seams.

Knowledge about the stabilization of prehistoric and historic ruins of adobe, stone, concrete, and brick, to understand the philosophy of ruins stabilization, and to understand the techniques for their reinforcement and maintenance.

Knowledge of Historic Building Systems, Technology, Structures

Knowledge about historic foundations ranging from simple piers or posts, to masonry foundations, to simple footings, to spread footings, or reverse arches.

Knowledge about historic structural systems such as masonry wall bearing construction and various combinations of masonry arches (semi-circular, elliptical, flat arches), vaulted construction (barrel vaults, elliptical vaults, tile vaults, domes, pendentives, combinations of iron and masonry), cavity wall construction. Knowledge about various types of historic wooden framing systems, including regional variations of pegged-braced frames, wooden wall trusses, wooden floor framing systems, wooden roof trusses, roof framing, historic balloon framing, platform framing. Knowledge about prefabrication of wall, floor and roof framing in early buildings and all the assorted connecting devices used for historic wooden structural systems including wooden pegs, nails, bolts, and tie rods.

Knowledge about historic exterior wall surfaces and materials including various forms of wooden siding, flushboards, clapboards, shingles, and shakes. Knowledge of the various craft practices used to fabricate and/or install these materials in various times and locales ranging from hand-splitting to machine made, from hand attached in various ways to fairly sophisticated attaching techniques. Knowledge about the craftsmanship and materials used to make historic walls to be able to repair, piece out, or replace damaged or deteriorated siding materials; to be able to estimate the damage to such covered materials as a result of energy retrofitting of frame walls or the introduction of high humidity in the building system.

Knowledge about historic roof covering materials such as ceramic tile, slate, thatch, composition, boarding, and wooden shingling in a wide range of materials and craftsmanship (split, side-lapped, sawn, shaped, face-nailed, etc.). Knowledge about shingling practices at

ridges, hips, valleys, chimneys and dormers. Knowledge about the great variety of metal roofing materials such as tin, copper, lead, iron and zinc. Knowledge about historic flat roofing systems with built in rain water disposal. Knowledge about historic flashing and contemporary flashing details to be able to solve problems around dormers, vents, skylights, chimneys, turrets, and other complex roof features.

Knowledge about historic window systems: single hung, double hung, and casement systems with sash, frames, weights and/or associated hardware. Knowledge about the evolution of muntin profiles. Knowledge about historic glass types, such as crown glass, broad glass; their physical characteristics, thickness, color and visual qualities due to their manufacturing processes; later glass products, such as plate glass, beveled glass, etched glass, decorative glass, stained glass, modern glass, structural glass, glass block. Knowledge about metal sash systems and their historical development.

Knowledge about historic flooring materials and floor coverings from the whole spectrum of early wooden flooring: pegged, face-nailed, blind-nailed, butt joints, tongue and groove, random widths, matched widths. Knowledge about the hierarchy of floor treatments relative to the social importance of the space. Knowledge about historic floor finishes, early flooring maintenance practices, knowledge about later hardwood flooring, parquet and decorative flooring. Knowledge about historic tile, marble, and other stone and/or brick flooring. Knowledge about historic floor coverings such as carpets, painted floor cloths, linoleum.

Knowledge of historic log construction practices as they varied from time, place, and ethnic influence. Knowledge of construction techniques of these materials including dry laid foundations, notching, chinking, or tapered ends on log walls, and other methods incorporated traditionally to prevent deterioration. Knowledge of where vernacular materials are most likely to deteriorate to determine the most effective method for affecting repairs.

Knowledge about historic adobe construction; knowledge about adobe walling and mud plastering; knowledge about wooden vigas in ceilings; knowledge about rain water disposal; knowledge about fireplaces and chimneys; knowledge about adobe walls and enclosures.

Knowledge about historic ships and maritime facilities such as ship building yards, docks, rope making structures, etc.

Knowledge of Historic Building Components

Knowledge about historic building components and mechanical systems to identify clues as to their existence and/or presence where appropriate; and knowledge about the introduction of new mechanical equipment and systems into historic buildings to minimize damage to surviving historic mechanical equipment where appropriate as well as minimizing damage to historic fabric and historic character including the imaginative use of heat registers, unused fireplaces and flues, etc.

Knowledge about historic heating equipment, such as open stoves, closed stoves and the development of central heating from the early masonry furnaces, combinations of masonry and iron, to modern furnaces with fireboxes and ductwork; development of furnaces for hot air or hot water with all their appurtenances including ductwork or radiators and piping.

Knowledge about the development of historic ventilation systems ranging from louvered openings, internal planning designed to promote cross circulation, ceiling louvers with wooden ductwork for public buildings to forced air systems.

Knowledge about historic kitchen cooking equipment, stoves, ovens.

Knowledge about historic lighting equipment fixtures ranging from portable lighting

devices, and permanent fixtures, gaslighting fixtures, electrical lighting fixtures (and wiring installations).

Knowledge about historic lightning suppression equipment including lightning rods and conductors for buildings and trees.

Knowledge about historic plumbing equipment and installations including conductor pipes for cisterns and indoor plumbing for kitchens and bathrooms.

Knowledge about historic fire suppression systems from leather buckets to glass bottles.

Knowledge about historic building components, that is, purchasable manufactured off-site items including such things as door hardware, window hardware, bell systems, shutter hardware.

Knowledge about historic ornamental iron work (wrought iron and cast iron), such as porch railings, fences, gateways, cellar window grills, roof cresting, etc.

Knowledge of Historic Moldings and Decorative Elements

Knowledge about the history of architectural moldings and related details; knowledge about how to identify and how to name them; knowledge about how they were executed in different materials; knowledge about machine and hand tools used to execute the moldings (for example, the use of planes and how moldings were pieced together to minimize wasting wood); knowledge about the purpose of moldings in covering joints and allowing for expansion and contraction.

Knowledge about historic plaster walls, moldings, and decorative features; knowledge about plastering craft practices (with or without plaster "grounds") and how these practices can be used as dating tools.

Knowledge of Historic Finishes

Knowledge about historic house painting, exterior and interior, utilizing the various finishes, paints and painting practices, including the use of white washes, milk paints, oil paints, calcimine, varnishes, and shellacs.

Knowledge about historic paint materials, pigments, mediums, and driers.

Knowledge about historic priming practices (relative to interiors) and paint practices to be able to know where to look for evidence of various painting practices and to be able to interpret paint layers.

Knowledge about historic painting of masonry walls, pencilling of mortar joints, historic painting of roofing.

Knowledge about historic marbling practices (exterior and interior), and historic graining practices and the tools used to imitate various woods for interior doors, baseboards, wainscotting, and other woodwork. Knowledge about other historic painting practices such as dark baseboards, stencilled borders, polychromy, and the whole range of decorative wall and ceiling painting in the Victorian era.

Knowledge about historic paint materials and practices to be able to conduct paint color research and to be able to use paints and painting practices as dating "tools."

Diagnosis and Treatments: Principles and Practice

Knowledge about evaluating the whole range of wood preservation problems including poor original materials, poor original workmansip, damage due to neglect, overstress, high humidity and moisture problems, insect attack, deterioration of joints and connecting devices, embrittlement. Knowledge about techniques for treating and stabilizing dry rot in historic wood including understanding the mechanisms of fungal decay to be able to

identify in the early stages the several types of fungal decay and how to treat. Knowledge about the various fungicides, their appropriateness and their hazards. Knowledge about dealing with insect infestations and damage.

Knowledge about the structural reinforcement of historic wood. Knowledge about various physical and chemical repairs, and treatments such as piecing out with new materials in kind, or splicing with dissimilar materials. Knowledge about the various systems for wood epoxy reinforcement (WER), including knowledge about how to formulate appropriate epoxy consolidants with an understanding of the various kinds of resins, curing agents and extenders and methods of application of stabilizers alone or in combination with wood patching to assure workability for decorative members and fragile parts such as window muntins that such consolidation, repair and patching methodologies should respect the original materials in terms of strength, expansion and contraction and visual characteristics.

Knowledge about general woodworking and millwork practices such as the appropriate use of other woods and substitute materials where original species or other qualities of the wood are no longer available. Knowledge about the appropriateness of hand tools vs. machine tools including sanding, back priming, the effects of various chemical treatments including fire retardant chemicals. Knowledge about how to reproduce historic wooden moldings.

Knowledge about various preservation treatments for historic brick and stone masonry to deal with such problems as spalling, graffiti, crumbling, moisture movement such as rising damp, efflorescence, staining, cracking and detachment. Such treatments range from partial replacement, plastic repair, mechanical attachment devices, chemical consolidation, coatings, and damp proofing methodologies. Ability to identify inherent weaknesses in materials and systems; identifying natural agents of deterioration; identifying built-in design flaws, human changes, alterations, or interventions that are contributing to materials and systems deterioration.

Knowledge about techniques for cleaning historic structures to be able to understand the need and methods for testing and the effect of weather and temperature in determining the best cleaning method; to be able to match the technique to the material and condition; to be able to understand the chemical interaction between building materials and the cleaning agents and the effect those agents can have on those portions of the historic structure not intended for cleaning, for example, cleaning the cast iron facade by sandblasting while protecting the wooden window sash.

Knowledge about coatings, sealants, and elastomeric compounds; knowledge about their appropriateness, as well as the dangers associated with their use as they relate to historic structure systems.

Knowledge about specialized techniques for cleaning historic interiors and surfaces such as plaster, bare wood, painted wood, marble, decorative arts, etc.

Knowledge about repointing of historic brick structures to understand the design and impact of the craft practices and the importance of the chemical and color composition of the mortar; to be able to identify and prescribe needed repointing; to be able to prescribe the careful removal of mortar if needed; to understand the purpose of mortar; and to understand the overall functioning of mortar in allowing for the dynamics of the structure with the attendant dangers from sealants and overstrength mortar formulas.

Knowledge about the present problems associated with historic concrete structures such as fortifications. Knowledge about problems associated with rusting and corrosion of steel reinforcement and others metals embedded in historic concrete such as steel windows. Knowledge about the various

problems associated with historic concrete, including discoloration, pitting, spalling, moisture movement, expansion, soft surface, erosion, scaling, disintegration, and displacement. Knowledge about the range of repair materials that will be compatible with the color, appearance and performance of the concrete that is being repaired to be able to respond in the same way to changes in temperature and load. Knowledge about the limits and uses of different tests for concrete performance, including specific gravity, void ratio, percent absorption, sonic tests, compression tests, aggregate reactivity test and mineral analysis. Ability to identify inherent weaknesses in materials and systems; identifying natural agents of deterioration; identifying built-in design flaws, human changes, alterations, or interventions that are contributing to materials and systems deterioration. Knowledge about investigative techniques for evaluation of damage in historic concrete and selection of repair methods.

Knowledge about the causes of deterioration of various historic metals including corrosion, weathering, galvanic action, physical and mechanical breakdowns such as creep and fatigue. Knowledge about general preservation methods relevant to specific metals including those metals used in more recent buildings such as Monel, and various alloys of aluminum. Ability to identify inherent weaknesses in materials and systems; identifying natural agents of deterioration; identifying built-in design flaws, human changes, alterations, or interventions that are contributing to materials and systems deterioration.

Knowledge about various subsoil conditions affecting historic structures including such factors as water tables, ground water movement, the effects of nearby excavation or archeology, underground utility lines, irrigation systems, tree plantings, and deep excavations for adjacent structures above and below surface.

Understanding the principles and practices of soil stabilization and reinforcement of historic masonry and wooden systems to strengthen and supplement the original system where possible and to provide a new system that will minimize the loss of historic fabric and meet structural requirements. For example, knowledge about soil stabilization, grouting, and other techniques to deal with differential settlement and other foundation damage. Knowledge about underpinning practices and needling to develop new spread footings for better distribution of imposed live and dead loads. Knowledge of how to monitor and evaluate the soil subsidence.

Understanding techniques for monitoring structural movement, cracks, deflection, the effects of vibration in historic structures; knowledge about the technology for monitoring crack movement using such devices as strain gauges, electronic gauges, engineering "tell tales". Understanding testing of historic materials, where appropriate, to determine their structural capacities in tension, compression, shear, etc. Understanding how to evaluate historic structural systems that are indeterminate. Understanding the structural qualities that are contributed by such membranes of historic buildings as flooring, lathing, and sheathing. Ability to diagnose structural movement which could be a function of soil subsidence, excavations, changes of water table; skill in diagnosing weaknesses in the structural system or connecting joints that are contributing to distortion, subsidence, deflection, etc.

Knowledge of present construction practices and materials and their interaction with historic methods and materials to produce the correct restoration appearances with effective construction.

Knowledge about evaluating historic window system problems, their routine maintenance, repair, replacement, weatherstripping, and thermal retrofitting.

Understanding the need to design a Heating/Ventilation/Air Conditioning (HVAC) system to meet the use and occupancy needs

of the historic structure without causing extensive loss of historic fabric or creating an HVAC system that is visually inappropriate to the structure's historic character or one that will cause excessive vibration or noise as a result of introducing new equipment. Understanding how to take into account the existence of historic mechanical equipment and their possible reuse. Understanding how to use the configuration of the building in the design and distribution of mechanical equipment, be it heating, cooling, electrical, plumbing, fire detection, whatever. One of the most difficult aspects of restoration work is understanding how to design an HVAC system that will meet the needs of both the historic structure and any objects that may be exhibited. Understanding the interrelationship between certain kinds of energy retrofitting such as insulating cavity walls with the installation of environmental control equipment that might have the effect of introducing condensation into the wall or increasing the moisture level of wooden members embedded in the masonry.

Understanding fire protection planning principles; understanding how to analyze the historic structure for fire risks. Knowledge of current building codes and knowledge of the National Fire Protection Association guidelines and technical information. Knowledge of the various kinds of equipment, products and services related to fire detection and fire suppression. Understanding the various factors for selecting the use of such equipment and systems when historic structures are also being used for the exhibit of museum objects.

Understanding the planning considerations for security of grounds and structures at historic properties; planning for the various aspects of physical security devices, such as, bars on windows, locking systems; knowledge about and the electronic intrusive and detector systems that may be tied into surveillance of grounds, windows and interior spaces. Planning the coordination of security planning and equipment and fire detection systems with local law officials.

Knowledge about the importance of energy conservation as a national issue; knowledge about energy conservation design and retrofit; knowledge about the concept of embodied energy and the planning approaches to energy conservation; knowledge about how to analyze an historic structure and its use in terms of energy conservation; knowledge about the payback aspects vs. the outlay costs; knowledge about window retrofitting, solar devices, passive energy devices, such as awnings, and the appropriateness or inappropriateness of tinted and mirror glass. Knowledge about the design, installation and operation of museum and other special environmental systems in historic structures.

Knowledge about seismic requirements and retrofit techniques for historic structures to be able to assess existing seismic features, to identify and incorporate any needed change to the historic structure so as to minimize the impact on historic character and integrity.

Knowledge of chemistry in the context of practical materials, e.g. the nature of chemical bonding and reactions, chemical nomenclature of construction materials, and reactions in inorganic systems like masonry deterioration and the corrosion of metals.

Knowledge about various methods for consolidation and reattachment of historic and prehistoric plasters and paint where such plasters and/or paint have been damaged by water or where the plaster keys have been broken off.

Knowledge about the effects of moisture and the effects of pollutants and moisture borne pollutants on historic structures; knowledge about moisture protection, and the processes of materials degradation in the presence of moisture. Ability to diagnose the wide range of moisture problems that are contributing to dry rot, deterioration, settlement, and finish failures of stuccoes and paints. Knowledge about monitoring moisture both externally and internally within building materials and within wall systems, analyzing the effects of dissolved salts, sulfates, and nitrates as a result of moisture migration.

Understanding building ecology -- the building as a historic ecosystem.

Knowledge about the impact of maintenance practices on the historic structure; knowledge of cyclical maintenance needs; knowledge of how to train maintenance personnel in appropriate maintenance techniques for historic structures; knowledge of how to prepare written maintenance guidelines. Knowledge of maintenance practices in the National Park Service. Ability to diagnose the maintenance practices that are contributing to materials or systems deterioration.

Knowledge about potential health dangers that may be found in historic structures -- e.g. lead paints, pigeon droppings, asbestos, in order to safely conduct investigations and to advise construction crews on precautions to be taken.

Knowledge about insect, pest, and fungal infestations in historic structures which would include recognition and identification; evidence of borings, tunnels, holes, frass and methods of control and treatment; the problems and possible consequences of treatment on the historic structure. (For example, the difference in treating airborne vs. subterranean termites, and the impact of those treatments on historic materials, finishes, etc.) Knowledge about Integrated Pest Management.

Knowledge about the hazards of historic and non-historic plant materials such as vines, mosses, algae and lichens on historic structures and the chemical interaction of these plant materials with various building materials and the physical forces that they generate. For example, ivy when growing on brick walls generates an acid that dissolves mortar. Understanding the possible hazards associated with the use of herbicides, ground poisons, and other chemicals used to control or destroy plants.

Putting It All Together: The Historic Structure Assessment, the Historic Structure Report, and the Historic Structure Preservation Guide

National Park Service Historical Architects prepare the above documents to record the historic significance, character and fabric of the structure with its existing condition; to document the reasons for the treatments they recommended; to record the new information they uncovered in the course of the work; to record the way the structure looked after treatment with a description of the changes that occurred in bringing the planned treatment to completion; to provide a blueprint for the future caretakers (both historical architects and maintenance personnel) on how to best maintain the historic structure; and to provide a written legacy to future architects and generations of Americans on the historic fabric they were privy to. The preparation of these documents is unique to the National Park Service and, coupled with the successful treatment of historic structures to prolong their existence, is the other primary reason for learning all of the skills and understanding described previously.

Historic Structure Assessment

Knowledge about the role of the Historic Structure Assessment in planning and the decision making process and a complete understanding of the elements that comprise that Assessment. The ability to make decisions about the need for the information and the appropriate level of investigation is critical in this information collection process. Typical elements of an Historic Structure Assessment are:

--statement of structure's significance using National Register criteria
--brief narrative of the known anthropological/archeological, historical, architectural/engineering, and landscape data about the structure and its setting
--list of completed reports and proposed research
--names of owners, architects, designers, contractors, etc. and dates, related to the

structure's construction
--list of the changes and additions since original construction with appropriate references, photographs and drawings
--list of comparable structures in vicinity or prototypes elsewhere
--reference source documents and plans
--inventory of historic fabric, and if accessible, the structure and infrastructure systems
--assessment of integrity of fabric and identify elements that are original or of a significant later addition
--identification of earlier restoration or quality repair work
--description of physical condition of structure analyzing the probable causes of deterioration; including (where applicable) the envelope, structural system, interior spaces, finishes and fixtures, HVAC, plumbing, electric, fire and security systems, the site and its landscape elements
--statement of treatment objectives and manner of meeting those objectives
--recommendations for treatment -- preservation, rehabilitation, restoration, reconstruction, interim stabilization
--evaluation of recommended treatment relative to policy, management, and operations considerations:
  -for the proposed or interim use
  -if the structure is furnished or used as a museum
  -security and fire protection
  -environmental systems code compliance and handicapped accessibility
--describe the proposed use and the foreseeable impact it will have on the historic character, integrity, and significance of the structure and its fabric
--evaluate the impact of treatment and use on interpretive potential and on archeological or collections management
--suggest treatments for mitigation, repair, or replacement of deteriorating elements or systems
--with photographs, overlays, sketches or drawings define the scope of the work
--estimate costs. For major interventions, these should be Class C estimates
--identify the planning document(s), cooperative agreements, or other documents relating to the treatment and use, the structure's management or furnishings.

Historic Structure Report

Knowledge about the role of the Historic Structure Report in planning and the decision making process. A complete understanding of the elements that comprise the Historic Structure Report and how the Historic Structure Assessment is important. Typical elements for consideration in a rehabilitation, restoration or reconstruction treatment are:
--justify the treatment, if rehabilitation, restoration, or reconstruction, relative to the criteria in the "Management Policies" and NPS-28 Treatment Standards and the structure; if these policies and standards cannot be met, recommend changes in treatments or uses
--evaluate the impact of the use on the integrity of the structure, including the effect of compliance with regulations on the integrity of the structure
--analyze impact of proposed action on the structure, its contents (if any), and the historic scene per 36 CFR 800.3; if any potential adverse effects are anticipated, recommend ways to avoid or mitigate
--narratively and graphic lly describe the context, appearance, occupation, and use of the structure and its setting during significant periods or over time, based on documents, oral history, or physical evidence. Utilize local knowledge and expertise regarding the structure, previous owners, and local records. Knowledge about how to interpret the historical documents in the context of early building practices. Cite all sources.
--describe and record existing conditions using measured drawings and photography prepared to HABS/HAER standards
--identify the factors affecting preservation of the structure, e.g. material, structural, environmental, human usage
--recommend ways of mitigating the impact of these factors, including any constraints on use
--prepare an engineering report on safety and load-bearing limits as appropriate for use or apparent condition

--recommend changes as needed, in the approved treatment or use based on documentary or physical evidence, the condition of the structure or other findings
--specifically delineate the steps for treatment within the categories of preservation, rehabilitation, restoration or reconstruction
--prepare preliminary drawings, with appropriate details, engineering designs, specifications and Class C estimates for the approved treatments
--evaluate need for further study prior to treatment and suggest sources
--update estimating detail (Form 10-802), provide cost estimates for recommendations with review by appropriate specialists
--provide recommendations for documenting, cataloging, conserving, and storing of objects, documents, records, photographs, negatives, drawings, and tapes collected or produced as a result of the study
--record all fabric analyses performed, e.g. paint, mortar; listing basic data with specific recommendations for treatment
--assess future research potential
--provide annotated bibliography of sources.

Data obtained during treatment and not previously included in the Historic Structure Report should be included in an addendum. Further addenda are appropriate whenever new data becomes available.

Historic Structure Preservation Guide

Knowledge about the historical architect's role in preparing an Historic Structure Preservation Guide (HSPG) directing preservation maintenance activities on specific historic and prehistoric structures once the structures are in a maintainable condition. The HSPG also serves as a reference for programming continued housekeeping, routine and cyclic preservation maintenance for park maintenance personnel and is tied to the park Maintenance Management System.

Skills Needed in Planning and Undertaking Historic Preservation Projects

Resource Data Collection and Documentation Skills

Ability to conduct historical/documentary, archival research. Skill in how to find or locate available sources for references or guides in preservation work. Knowledge about earlier building practices, materials, costs, and nomenclature, so as to be able to interpret and derive "clues" from historic documentation, including vouchers, insurance surveys, plans, photographs, etc. Knowledge about regional variation as to uses and dates of use.

Knowledge about how to conduct a "walk-through" and "read" a building, that is, how to assess the various aspects of a structure's historic character, to comprehend the structure in terms of its character, its construction, its integrity, its physical evolution, its craftsmanship, its condition, and the probable impact of the proposed new use.

Knowledge about architectural moldings, their nomenclature and construction. Knowledge about the evolution of moldings by function and by style, that is, how a doorway architrave evolves with style from Georgian to Greek Revival to be able to use it as an aid in assessing the physical evolution of the building. Knowledge about how to "read" moldings for style and crispness of detail to be able to interpret these subtle dating clues.

Ability to take photographs to assist in drawing the structure and to serve as an accurate record of the structure; and ability to use historic photographs in research of the structure.

Knowledge about how to record existing structure configurations through written descriptions, sketches, measured drawings, photographs, etc.; how to make existing condition measured drawings of historic structures.

Skill in geometry and trigonometry to be able

to triangulate with a tape or level for the purposes of recording historic sites.

Knowledge of terrestrial surveying techniques and the use and interpretation of measured drawings of historic structures both urban and rural to assist in preservation of site and structure.

Knowledge about the use of other recording equipment and methodologies such as stereophotogrammetry, rectified photography

Knowledge about historic graphics such as engineering drawings, engravings, historic photographs, renderings, different typefaces, styles and types of signs, use of colors and design to be able to learn more about the historic structure and to be able to graphically present information in Historic Structures Reports, perspectives, presentations for public hearings or interpretive use, and working drawings.

Aptitude for illustrative work, to be able for example, to draw isometric charts, flow charts, exploded view diagrams and interpretive drawings; isometric, "exploded" and cut-away views of assembled structures, machinery, etc.

Skill in preparing reverse perspectives from historic photographs, to be able to design and correctly size missing architectural features, exterior or interior, such as porches, cornices, cupolas, doorway enframements, etc.

Ability to effectively prepare and illustrate technical investigative reports for problem areas in historic structures.

Historic Fabric Investigation and Diagnostic Skills

Knowledge about how to conduct non-destructive investigation as to evolution and condition to prevent unnecessary damage and loss of historic fabric in the attempt to discern the evolution and physical condition of the structure.

Knowledge about how to use dating "tools" for structures such as nails, tool marks, dendrochronology, wood species, mouldings, other period details, and regional practices to be able to sort out original construction from later additions, to be able to identify later repairs and alterations of the structure.

Knowledge about how to take and record moulding profiles.

Knowledge about the use of portable X-ray equipment for investigation of hidden components in wooden frame buildings looking for evidence of earlier structural modifications; looking for evidence of hidden deterioration; looking for evidence of repairs or alterations as evidenced by earlier nails; knowledge about how to specify and direct such X-ray examination by others such as contract specialist. Knowledge about the possible radiation hazards.

Knowledge of techniques used to identify and examine building materials relevant to building conservation, including microscopy, qualitative chemical analysis, identification of types of early paints and pigments, examination of early plasters to determine gypsum content, composition, and source of efflorescences.

Knowledge about how to remove and document paint samples and how to analyze paints and finishes and knowledge about how to use the analysis and take into account the changes that may have occurred to the paints or finishes over time; and how to use the analysis to aid in producing new paints or finishes that will be historically correct in all respects.

Knowledge about how to collect and document mortar samples so that it can be analyzed to be used as a clue to the evolution of a building, for example, as evidence of new additions or maintenance practices; and to provide information about the constituents (cement, sand, fiber, etc.); information about the compressive and shear strength of the mortar; and information about the visual qualities of the mortar (sand color, etc.)

Knowledge about proper documentation of materials removed during physical investigation, e.g. assignment of individual Field Specimen numbers or lot numbers, preparation of sketches, drawings, and photos of conditions during the investigative phase (as the fabric is being examined and/or removed). Knowledge about the ultimate accessioning and cataloging of objects removed or discovered during the investigative phase, including archeological artifacts, or during excavations related to the construction phase.

Knowledge about the safety measures needed for removal of certain historic materials or features, such as plaster ceilings, asbestos siding, or features that are structurally unsound.

Skill in diagnosing problems related to insect infestations, biological actions; skill in diagnosing problems related to dissimilar materials in close juxtaposition; diagnosing problems related to metals corrosion, galvanic action, rust, etc.; skill in diagnosing structural capabilities.

Plan and Design Solutions and Treatments

Ability to prescribe temporary stabilization procedures. Ability to plan and design short term or medium term stabilization treatments that are differentiated from permanent solutions.

Knowledge about planning and designing the appropriate preservation treatment(s) -- preservation, rehabilitation, restoration, reconstruction, etc., for such diverse needs as materials repair, structural stabilization; fire detection/suppression systems; HVAC and other infrastructure systems; security systems; proposed additions to historic structures; and accessibility for the disabled: to be able to produce architectural specifications, cost estimates, working drawings, and related contract documents; to work with manufacturers to develop solutions based on current technological capability; to communicate with preservation craftspeople to develop solutions based on craft capability and material availability and limitations; to make appropriate use of synthetic materials, such as fiberglass, for effecting repairs or patching of wood and stone.

Skill in producing historic structure reports; to review and comment on reports by other professional disciplines, shop drawings, etc.; and historic structure preservation guides; to plan systems and programs for inspections, monitoring, and cyclical maintenance.

Project Execution and Completion

Knowledge and training as Contracting Officer's Technical Representative (COTR) to keep control of project and to draw on expertise as needed within Service.

Knowledge of construction management principles, to be able to deal with the logistics of obtaining specialized materials and skills; skill in scheduling and supervising preservation and architectural conservation projects.

Skill in preventing possible damage or destruction of historic and/or archeological evidence in the process of construction.

Knowledge of the safety and health hazards involved in working on historic structures and in connection with undertaking various preservation treatments. Knowledge about potential liabilities, both personal and property damage in connection with construction and preservation activities, for the associated workers, visitors, and the public.

Ability to provide field inspection of and coordination of contractors and craftspeople once construction phase has started.

Knowledge about the removal, identification, salvage, and storage of historic structure components and artifacts, during construction to assure their temporary (or permanent) preservation.

Ability to record the project graphically, photographically and narratively; to produce as-built records upon completion; and to archivally file data generated by the project.

Selected Skills Needed by Historical Architects

Introduction

The **Selected Skills Needed by Historical Architects** expand approximately twenty basic Skills listed in the previous "Catalog" to comprise a starting point for career growth in historic architecture. These twenty skills have been selected by the authors as "must knows" for historical architects.

The format for each **Selected Skill** is as follows: the Catalog Skill is repeated and a basic knowledge level is suggested. Examples of basic tasks in this topic area are given as well as what a more advanced level might include. Finally, we describe what an imaginary expert might know and be able to do. The intent here is to suggest ways to expand basic Catalog Skills, thus helping the architect to fill-in or personalize career plans and goals or the needs of their NPS unit. We have also provided a selected bibliography. Some of these texts are in print, many will be hard to find or are only available from a good architectural library. (Note: The books in the Selected Bibliographies are not placed in any specific order of importance.) With this information, you can work at your own pace or with others to make the topic and the knowledge your own.

There are obviously varying levels of proficiency in both understanding and being able to work effectively with historic building materials and systems:

> For example, at the Basic Level, an architect acquires familiarity with the literature on the subject and has a limited experience in applying this knowledge to real projects.
>
> At an Advanced Level, the architect has knowledge about the manufacturing, assembly and construction processes; has knowledge of a variety of periods and different kinds of materials beyond those normally encountered in a geographical area of work; can prepare a paper for publication, and/or can teach a technical training session on the topic. The architect has knowledge about where the resource people are in a given region.
>
> The Master Level comes from years of observation and requires a breadth and depth of knowledge such that the architect is sought out as an expert, can demonstrate techniques and speak on both specific topics and on a nationwide basis (broader range). The architect has knowledge about where the specialized resource people are throughout the country. The architect prepares papers or teaches on new discoveries in historic materials or on new documentation discoveries.

You will note that specific historic building materials are mentioned in describing the differing levels of proficiency. The most well known materials are equated with the Basic Level; the more unusual or uncommon are equated with the Advanced Level. The validity of these levels is affected by the geographic location of the architect--some historic building materials and historic building practices are common to a particular region. For instance, in the Southwest you would need to be familiar with the Chaco culture stonework and adobe (far from being advanced, this would become your basic level). These levels are provided to suggest the depth and complexity that comes from a career long pursuit of preservation technology. The placement of a skill at a different level is also affected by whether information is easily available on a topic, that is, some skills are hard to learn because there is a lack of literature and so acquiring in depth knowledge of the skill becomes a Master Level accomplishment. Whereas, if the information were more readily available, it might become a Basic Level skill.

These Selected Skills are a resource in developing a plan of study or work in consultation with your supervisor. The Washington Office of the National Park Service and/or the Regional Historical Architects are available for consultation on planning. For further information on participation and enrollment see **Participation in the Skills Development Plan.**

Research on Historic Materials, Historic Buildings, and Craft Practices

Ability to conduct historical/documentary, archival research. Skill in how to find or locate available sources for references or guides in preservation work. Knowledge about earlier building practices, materials, costs, and nomenclature, so as to be able to interpret and derive "clues" from historic documentation, including vouchers, insurance surveys, plans, photographs, etc. Knowledge about regional variation as to uses and dates of use.

Basic Level

--Ability to do research on such records as building permits, insurance records and surveys, Sanborn maps, street or city directories, inventories of estates, original architect's drawings and specifications, construction accounts and vouchers, personal diaries and correspondence, lawsuits and court records, contracts, Carpenters Company Rule Books, Builders Manuals, collections of early views including engravings, artists drawings, lithographs, photographs; oral history and personal interviews. While much of this research may be done by historians, historical architects are likely to need to interpret the data in light of their knowledge of building and craft practices and use of materials.

Advanced Level

--Research about building practices for the locale and for the region including for example practices that relate to stone quarrying, stone cutting, stone carving, transportation of stone and stone setting; to be able to interpret and understand construction vouchers, bills, nomenclature, etc.
--May also include technological studies not necessarily keyed to the building at hand, for example, machine sawn plaster lath in the 18th century was unique to a particular locale and one might assume that it was later plaster and not original.

Master Level

--Ability to conduct research on missing features by doing comparative studies as a part of the research of extant, similar or prototype buildings. Part of doing a comparative study would involve looking at collections of measured drawings.
--A broad and indepth knowledge of documentation and craft practices and the ability to do research on specialized building types such as churches, to be able to unravel the whole history of the building and what it looked like at each period including paint colors.

Selected Bibliography:

The Restoration Manual by Orin M. Bullock, Jr., Norwalk, Connecticut: 1966.

"Architectural Research in Restoration," by Lee H. Nelson, in Building Research magazine The Journal of the Building Research Institute, Sept.-Oct. 1964, Vol. 1, No. 5.

"Old-Time New England Magazine," has over the years published numerous building contracts that are useful and informative to that region.

"Positive Evidence: Using Photographs as Documents in Structural History," by Margaret Archibald, APT Bulletin, Vol. XII, No. 3, 1980, pages 62-92.

"Researching 19th-Century American Patents: The Journal of the Franklin Institute," by Carole L. Perrault, APT Bulletin, Vol. VIII, No. 2, 1976, page 24-36.

Tools for the Trades and Crafts: An Eighteenth Century Pattern Book R. Timmins and Sons, Birmingham by Kenneth D. Roberts, Fitzwilliam, New Hampshire: 1976. (Book Review by Peter J. Priess, APT Bulletin, Vol. IX, No. 1, 1977, pages 88-91.

"Incorporating Photographs into Working Drawings," by John J. Stewart, APT Bulletin, Vol. IX, No. 3, 1977, pages 21-29.

"The Use of Reverse Perspective in the Deduction of Plans and Elevations from Photographs," by Thomas J. Kane, APT Bulletin, Vol. IX, No. 3, 1977, pages 30-38.

"Philadelphia Bricks and the New Bern Jail," by Catherine W. Bishir, APT Bulletin, Vol. IX, No. 4, 1977, pages 62-66.

"Early Building Specifications," (three examples), APT Bulletin, Vol. V, No. 1, 1973, pages 68-101.

"Enhancement of Historic Photographs," by Harvie P. Jones, APT Bulletin, Vol. XI, No. 1, 1979, pages 4-12.

"Computer Image Processing of the Huntsville Depot Photograph," by Jerry Clark, APT Bulletin, Vol. XI, No. 1, 1979, pages 13-16.

"Computer Enhancement of Radiographic Films Use in Structural Investigation of an Historic Structure," by William Firschein, APT Bulletin, Vol. XIV, No. 2, 1982, pages 18-25.

"Photomicrography and the Stanton House Restoration," by Barbara E. Pearson, APT Bulletin, Vol. XVI, No. 3, 1983, pages 26-30.

"The Key-Year Dendrochronology Technique and Its Application in Dating Historic Structures in Maryland," by Herman J. Heikkenen and Mark R. Edwards, APT Bulletin, Vol. XV, No. 3, 1983, pages 2-25. (Letters and reply to Dendrochronology article in APT Bulletin, Vol. XVI, No. 2, 1984, pages 53-55.)

Historic Materials--Wood

Knowledge about wood as a historic building material; knowledge about wood's properties, performance, and limitations; knowledge about species of wood; knowledge about historic woodworking processes; knowledge about tools, "tool marks," and craftsmanship; knowledge about preservation treatments, repair and maintenance techniques that have become part of the historic fabric, for example, the kind of nails used, the way wood was glued or pieced in or dovetailed to distinguish later alterations and repairs as dating "tools."

Basic Level

--Visual identification of common wooden building materials.
--General knowledge of historic wood properties and characteristics such as strength, workability, durability.
--Manufacturing of wood and historic grading practices (flat sawn, quarter sawn, pit sawn, sash sawn, radial sawn, circular sawn), importance of density, effects of knots and other defects.
--Causes of deterioration, what are the mechanisms of rot.

Advanced Level

--Ability to use the knowledge about tool marks and tool technology as dating "tools".
--How to determine species and characteristics of less commonly used materials.
--Knowledge of the effects of ultraviolet light and embrittlement; the effects of chemical treatments on the durability of historic wood.
--Understanding the process of manufacturing millwork blades.
--Sources and/or methods of finding unusual materials.

Master Level

--Be able to demonstrate using hand tools and other techniques to reproduce historic materials and historic workmanship.
--Ability to grind molding blades.
--Be able to relate modern materials to historic materials and how to use modern woods to replicate historic woods, matching grains and using different species.

Selected Bibliography:

Modern Engineering Practice: Vol. XII, Ventilating, Heating, Plumbing, Carpentry, Index edited by Frank W. Gunsaulus, Chicago: 1906. pages 317-456.

Building Construction and Superintendence by F.E. Kidder, rev. and enlarged by Thomas Nolan, Part II Carpenters' Work, 9th edition rev., New York: 1915. pages 1-88.

"Mr. Smart's Circular Saw Mill c. 1815," by Orville W. Carroll, APT Bulletin, Vol. V, No. 1, 1973, pages 58-64.

"Sawdust Trail," by Charles E. Peterson, APT Bulletin, Vol. V, No. 2, 1973, pages 84-153.

"Restoration of the Bertolet Sawmill," by John M. Dickey, APT Bulletin, Vol. V, No. 2, 1973, pages 154-161.

"The Introduction of the Circular Saw in the Early 19th Century," by John O. Curtis, APT Bulletin, Vol. V, No. 2, 1973, pages 162-189.

The Framed Houses of Massachusetts Bay, 1625-1725 by Abbott Lowell Cummings, Cambridge, Mass.: 1979, especially see Chapter 4, "The Builders and Their Resources."

Dictionary of Tools Used in the Woodworking and Allied Trades, c. 1700-1970 by R.A. Salaman, London: 1975.

"Circular Saws and the History of Technology," by Norman Ball, APT Bulletin, Vol. VII, No. 3, 1975, pages 79-89.

"The Earliest Wood-Processing Industry in North America, 1607-23," by A.J.H. Richardson, APT Bulletin, Vol. V, No. 4, 1973, pages 81-84.

"Building in the North," by Angus Sherwood and Norman Wells, APT Bulletin, Vol. VI, No. 3, 1974, pages 1-25.

"The Use of Planks in Wall Construction," by T. Ritchie, APT Bulletin, Vol. VI, No. 3, 1974, pages 26-34.

"Indications for Research in the History of Wood-Processing Technology," by A.J.H. Richardson, APT Bulletin, Vol. VI, No. 3, 1974, pages 35-146.

"Historical Checklist of the Pines of Eastern North America," by Charles van Ravenswaay, Winterthur Portfolio 7, pages 175-215.

"Ohio Waterpowered Sawmills," by Donald A. Hutslar, Ohio History, Vol. 84, Nos. 1-2, Winter-Spring 1975, pages 1-56.

Building With Wood by John I. Rempel, Toronto, 1967.

Woodworking Tools 1600-1900 by Peter C. Welsh, contributions from the Museum of History and Technology Paper 51, Smithsonian Institution, Washington, D.C.: 1966.

Woodworking Tools at Shelburne Museum by Frank H. Wildung, Museum Panphlet Series No. 3, Shelburne, VT: 1957.

America's Wooden Age: Aspects of Its Early Technology by Brooke Hindle, Tarrytown, New York: 1975.

Historic Materials--Masonry

Knowledge about historic masonry materials such as brick, stone, terracotta and the mortars and stuccos used on them; knowledge about the history of masonry materials -- their ingredients, composition and manufacture; knowledge about the variations in regional materials, sizes of units, color; knowledge about the impact of the craft processes and changes in technology over time that affected the size and quality of the products, for example, handmade bricks versus machine made bricks; knowledge about the great variety of stones used for American building construction; the types, their properties and characteristics including geological information; knowledge about the history of the stone working industry; knowledge about the use of field stone versus cut stone; knowledge about the tools, craftsmanship and "tool marks" on walling; knowledge about bedding planes for stone and their importance in the integrity of the system.

Basic Level

--General knowledge of historic masonry and mortar properties and characteristics such as strength, workability, durability.
--Knowledge of how lime was produced historically including the burning of limestone and the hydration of lime.
--Be able to apply and demonstrate an undertanding of the Introduction to Early American Masonry or similar texts on the masonry building types in the area a person is working in.
--Understanding the basic differences between the materials and craft techniques involved (hand and machine manufactured bricks).
--Use knowledge of historic masonry practices as a dating "tool", to identify changes and alterations, to evaluate the maintenance that may have occurred over time (such as repointing).
--Ability to determine whether sedimentary stones have been installed properly relative to the bedding planes.
--Understanding the historic evolution of masonry materials to know the differences of their constituents, size, color, materials and character to use in combination with the above to prepare the Historic Structure Assessment, and/or the Historic Structure Report.
--Being able to apply this information to prepare specifications and/or direct the work for masonry repairs or replacement and be able to inspect materials to assure that work and materials meet the specifications and the Standards.
--Knowledge about historic painting practices on masonry, such as pencilling.

Advanced Level

--Knowledge of a variety of periods or different kinds of historic masonry other than that normally encountered in the incumbent's work area. Prepare a paper for publication or lead a training session on a subject like brickwork in early 19th century Tidewater Virginia, or river rock masonry on bungalows.
--More knowledge about manufacturing and construction processes.
--Knowledge of historic stuccos, their constituents, application, and stylistic attributes, such as scoring, rustication, pencilling, and surface finishes.
--Knowledge about the use of stuccos historically; their constituents and application; their stylistic attributes such as scoring, rustication, pensilling, and different surface finishes such as pointing the stucco to look like unit masonry.

Master Level

--More in depth knowledge with greater breadth, for example, knowledge about brickwork throughout the Mid-Atlantic states.
--Knowledge about more specialized subjects like cobblestone buildings and galletting in foundation joints.
--Knowledge of finish coats and renderings over wattle and daub.
--Knowledge of application of stucco over wood frame construction.
--Knowledge about regional uses of stucco.
--Knowledge about stucco attachments historically.
--Knowledge about modern formulations and applications of stucco to masonry including permastone.
--Knowledge about finish coats and renderings over wattle and daub.
--Knowledge about the application of stucco over wood frame structures.

Selected Bibliography:

Introduction to Early American Masonry ... by Harley J. McKee, Washington, D.C.: 1973.

"Notes on the Evolution of Virginia Brickwork from the 17th Century to late 18th Century," by Calder Loth, APT Bulletin, Vol. VI, No. 2, 1974, pages 82-120.

"Brick Bibliography" by John R. Volz, APT Bulletin, Vol. VII, No. 4, 1975, pages 38-49.

The Builders Dictionary ... (2 volumes) by A. Bettesworth and C. Hitch originally printed in 1734, reprinted by the Association for Preservation Technology, Washington, D.C.: 1981.

Comments on Virginia Brickwork before 1800 by Herbert A. Claiborne (Walpole Society, 1957)

Conservation of Historic Buildings by Bernard M. Feilden, London: 1982.

Stone: Properties, Durability in Man's Environment by Erhard M. Winkler, New York: 1973.

"Notes on the Treatment of Oil and Grease Staining on a Masonry Surface," by Frank G. Matero and Jo Ellen Freese, APT Bulletin, Vol. X, No. 2, 1978, pages 132-141.

"Early Ways of Quarrying and Working Stone in the United States," by Harley J. McKee, APT Bulletin, Vol. III, No. 1, 1971, pages 44-58.

Stones for Building and Decoration by George P. Merrill, second edition, New York: 1897. (First edition 1891.) Excellent material on physical and chemical properties of stone, where it is found and how and when it was used, including a section on weathering.

The Marble-Workers' Manual... translated from the French by M.L. Booth with an appendix concerning American marbles; Philadelphia: 1865.

"The Manufacture of Architectural Terracotta and Faience in the United Kingdom," by John Fidler, APT Bulletin, Vol XV, No. 2, 1983, pages 27-32.

"Chapter V, Strengths of Bricks, Stone, Mass-Concrete and Masonry," by Charles M. Gay in Kidder-Parker Architects and Builders Handbook by Frank E. Kidder and Harry Parker, 18th edition, New York: 1945.

International Library of Technology, Vol. 31D by International Textbook Company, Scranton: 1922. Includes chapters on Common Brickwork, Face and Ornamental Brickwork, Architectural Terra Cotta, Hollow Tile, Building Stone.

Building Construction and Superintendence by F.E. Kidder, rev. and enlarged by Thomas Nolan, Part I Masons' Work, 9th edition rev., New York: 1914. Includes Chapter IV on Limes, Cements and Mortars; Chapter V on Building Stones; Chapter VI on Cut-Stonework, Chapter VII on Bricks and Brickwork; Chapter VIII on Architectural Terra-cotta; Chapter IX on Fire-proofing of Buildings; and Chapter X on Concrete and Reinforced Concrete Construction.

The Building Trades Handbook by International Correspondence Schools, 5th edition, Scranton: 1924. Includes sections on Masonry, Brickwork, Terra-Cotta.

"A Search for Coade Stone in America," by Nathaniel P. Neblett, APT Bulletin, Vol. III, No. 4, 1971, pages 68-71.

"The Bricklayers Company of the City and County of Philadelphia," by George L. Wrenn III, APT Bulletin, Vol. III, No. 4, 1971, pages 72-75.

International Library of Technology Vol. 30B, on Masonry, Carpentry, Joinery and Steel Square: Scranton: 1909. Includes sections on "Cements," "Concrete Construction," "Stone Masonry," "Stone Arches."

Cyclopedia of Architecture, Carpentry and Building Vol. IV on Reinforced Concrete, Steam Fitting, Electricity, Chicago: 1908. Pages 11-134 on Reinforced Concrete.

"Chapter 5, Brick and Stone: Handicraft to Machine," by Harley J. McKee, in Building Early America by the Carpenters' Company of the City and County of Philadelphia, Charles E. Peterson, editor, Radnor, Pennsylvania: 1976.

The Role of Concrete in Conservation of Historic Buildings Cembureau, Paris, France: 1976

"Terra Cotta as a Building Material A Bibliography," by Theodore H.M. Prudon, a Supplement to the APT Communique, Vol. V, No. III, June 1976, (9 pages).

The Framed Houses of Massachusetts Bay, 1625-1725 by Abbott Lowell Cummings, Cambridge, Mass.: 1979

"Sawing Stone in Canada, 1816," by J.-Raymond Denault and A.J.H. Richardson, APT Bulletin, Vol. V, No. 4, 1973, pages 76-80.

The Story of Brick, by Charles Ellery Hall originally printed 1905, reprinted Thrills, New York: 1974?

"The Use of Sandstone in New York City in the 19th Century," by Frank G. Matero and Jeanne M. Teutonico, APT Bulletin, Vol. XIV, No. 2, 1982, pages 11-17.

A Treatise on Civil Engineering by D.H. Mahan, New York: 1873, 1875.

"Early Brick Laws in Massachusetts," by Orville W. Carroll, APT Bulletin, Vol. VIII, No. 2, 1976, pages 20-23.

"The 1894 Don Valley Pressed Brick Works Catalogue," with introduction by Jean Bacso, APT Bulletin, Vol. IX, No. 1, 1977, pages 30-73.

"Roman Stone and Other Decorative Artificial Stones," by T. Ritchie, APT Bulletin, Vol. X, No. 1, 1978, pages 20-34.

"Early Development of the Artistic Concrete Block: The Case of the Boyd Brothers," by Ann Gillespie, APT Bulletin, Vol. XI, No. 2, 1979, pages 30-52.

"Notes on Dichromatic Brickwork in Ontario," by T. Ritchie, APT Bulletin, Vol. XI, No. 2, 1979, pages 60-75.

"Stone Finishing Marks," by William J. Higgins, APT Bulletin, Vol. XI, No. 3, 1979, pages 11-34.

"The Making of Oil Brick in Virginia," by Calder Loth, APT Bulletin, Vol. XI, No. 3, 1979, pages 35-43.

"Notes on the Manufacture of Hand-Made Bricks" by Thomas L. McGrath (and 2 notes), APT Bulletin, Vol. XI, No. 3, 1979, pages 88-97.

"Report of Visit to Colorado Marble Quarry -- 1908," by Owen Brainard, introduction by Patrick Boyd Porter, APT Bulletin, Vol. XI, No. 3, 1979, pages 98-102.

"A History of the Tunnel Kiln and Other Kilns for Burning Bricks," by T. Ritchie, APT Bulletin, Vol. XII, No. 3, 1980, pages 46-61.

Historic Landscapes

Knowledge of historic designed landscapes, gardens, plantings including vistas, knowledge of vegetation and topography, knowledge of engineering in planning drainage and in planning pedestrian and vehicular circulation; knowledge of other landscape elements such as fencing, gates, walks, greenhouses, gazebos, bird houses, storm cellars, cemeteries; and knowledge of historic vernacular landscapes to be able to identify features, dates of changes, particular uses and time period; understanding how to record, preserve and maintain an historic landscape or historic vernacular landscape. Knowledge of historic landscape furnishings such as benches, lighting, sculpture, signage, and trash cans.

Basic Level

--Knowledge of architectural and landscape styles to know which landscape styles go with what buildings.
--Ability to recognize design intent in the landscape surrounding a historic building to be able to preserve the significant features during a restoration or other preservation treatment on the building.
--Knowledge of approximately 30 commonly used landscape plants; knowledge of how to have unknown plants identified and where to go for assistance.
--Knowledge of what the different architectural features in landscapes looked like at different periods in history, for example, what did fences and walls look like?
--Knowledge about basic drainage systems such as storm drains, drainage of water away from buildings, underground drains, etc.
--Ability to have some recognition of scale and character in foundation plantings.

Advanced Level

--Knowledge of how plants were used at different time periods, knowledge of the commonly used plant materials at different times; and knowledge of how plants are used today.
--Knowledge of surveying practices to be able to do topographies. Ability to do field measurements.
--Ability to identify plant materials or species for a survey.
--Knowledge about substitute plant materials.
--Ability to specify plants suitable for foundation plantings.

Master Level

--Knowledge of the history of early urban streets, drainage, sewers, conversion of streams into underground drains, for example in Philadelphia how grading the streets was done to improve drainage, or in New Orleans how the system of ponds was developed to the water could drain into those.
--Knowledge of patent cast stone pavings and special pattern bricks used for walkways.

Selected Bibliography:

"Eighteenth Century Cultural Process in Delaware Valley Folk Building," by Henry Glassie, Winterthur Portfolio 7, pages 29-57, 1972, Charlottesville, VA.

"Landscape Preservation," APT Bulletin, Vol. XV, No. 4, 1983 (Note: the entire issue is on this subject).

The Yearbook of Landscape Architecture: Historic Preservation by Richard L. Austin et al, editors, New York: 1983.

Landscapes and Gardens for Historic Buildings by Rudy Favretti and Joy Putnam Favretti, Nashville, 1978.

Cultural Landscapes: Rural Historic Districts in the National Park Service by Robert Z. Melnick, Washington, D.C.: 1984.

Reading the Landscape of America by May Theilgaard Watts, New York: 1975.

Cottage Residences... by Andrew Jackson Downing, New York & London, many editions from 1842 to 1868.

Rural Essays... by Andrew Jackson Downing, New York, many editions from 1853 to 1881.

A Treatise on the Theory an Practice of Landscape Gardening Adapted to North America by Andrew Jackson Downing, New York & London, many editions from 1841 to 1879.

Design on the Land by Norman T. Newton, Cambridge, Mass.: 1971.

Common Landscape of America -- 1580-1845 by John R. Stilgoe, New Haven, CT: 1982.

"Downing's Newburgh Villa," by Arthur Channing Downs, Jr., APT Bulletin, Vol. IV, No. 3/4, 1972, pages 1-113.

"Historic Landscape Restoration in the United States and Canada: An Annotated Source Outline," compiled by Meredith Sykes and John Stewart, APT Bulletin, Vol. IV, No., 3/4, 1972, pages 114-158.

Fences, Gates and Bridges, by George A. Martin, Brattleboro, Vermont: 1974.

Barns, Sheds and Outbuildings by Bryon D. Halsted, Brattleboro, Vermont: 1977.

"Warren H. Manning's Drawings," by Robert R. Harvey, APT Bulletin, Vol. X, No. 1, 1978, pages 38-49.

"The Introduction of the American Water Ram, ca. 1843-1850," by Arthur Channing Downs, Jr., APT Bulletin, Vol. VII, No. 4, 1975, pages 56-103.

"The American Water Ram, Part II," by Arthur Channing Downs, Jr., APT Bulletin, Vol. XI, No. 1, 1979, pages 81-94.

"The Landscape: The Emerging Historic Preservation Resource," by William H. Tishler, APT Bulletin, Vol. XI, No. 4, 1979, pages 9-25.

"Historic Gardens in Canada and the United States," edited by John J. Stewart, APT Newsletter, Vol. II, No. III, June 1973 (22 pages).

"How to Evaluate and Nominate Designed Historic Landscapes," by J. Timothy Keller and Genevieve P. Keller, National Register of Historic Places Bulletin # 18 (includes a 3-4 page bibliography). Washington, D.C.: 1986.

"Ornamental Ironwork," section in Vol. III of A Treatise on Architecture and Building Construction International Correspondence Schools, Scranton, Pennsylvania: 1899.

"The Late Nineteenth Century Development of the Queen Square Gardens, Charlottetown, Prince Edward Island," by Mary K. Cullen, APT Bulletin, Vol. IX, No. 3, 1977, pages 1-20.

"George Laing -- Landscape Gardener, Hamilton, Canada West 1808 (Aberdeen) -- 1871 (Hamilton)," by Paul Grimwood, Owen R. Scott, and Marilyn Watson, APT Bulletin, Vol. IX, No. 3, 1977, pages 52-64.

"Gardens of Shelburne, Nova Scotia 1785-1820," by Mary Mackay Harvey, APT Bulletin, Vol. VII, No. 2, 1975, page 32-72.

"The Case for Commemoration of Historic Landscapes and Gardens," by John Stewart and Susan Buggey, APT Bulletin, Vol. VII, No. 2, 1975, pages 99-123.

"A Short Note on Foundation Planting and the Problem of Over-Growth," by John J. Stewart, APT Bulletin, Vol. VIII, No. 3, 1976, pages 74-80.

"Landscape Archeology: Existing Plant Material on Historic Sites as Evidence of Buried Features and as Survivors of Historic Species," by John J. Stewart, APT Bulletin, Vol. IX, No. 3, 1977, pages 65-72.

"Documenting a Victorian Landscape in the Midwest," by Robert R. Harvey, APT Bulletin, Vol. IX, No. 3, 1977, pages 73-99.

"Restoration of the Centennial Fence at Washington's Headquarters State Historic Site," by Thomas D. Ciampa and Nancy Goldenberg, APT Bulletin, Vol. XIV, No. 3, 1982, pages 26-35.

Note: be sure and check for the illustrated county histories that were common in the 19th century, they are likely to have illustrations of farm settings which would be useful in showing fencing patterns and out buildings.

Historic Materials -- Moldings

Knowledge about architectural moldings, their nomenclature and construction. Knowledge about the evolution of moldings by function and by style, that is, how a doorway architrave evolves with style from Georgian to Greek Revival to be able to use it as an aid in assessing the physical evolution of the building. Knowledge about how to "read" moldings for style and crispness of detail to be able to interpret these subtle dating clues.

Basic Level

--Knowledge about general molding configurations for various architectural features such as cornices, chair rails, architraves, for various periods and styles of architecture.
--Knowledge about moldings and the tools needed to make them whether the moldings were made of wood or plaster.
--Understanding of the attachments for moldings and how this can be used as a dating "tool."
--Ability to sketch, draw and record moldings.
--Ability to use moldings as dating tools such as muntin profiles.
--Knowledge about their function and style and construction, for example every molding type has a specific function.

Advanced Level

--Knowledge of how moldings were embellished with carvings and the various types of carving.

Master Level

--Knowledge in more depth and in a given locale or region that would reflect your knowledge about the economic status of the owners, for example, of the difference between high style, middle style and specification-built workers houses.
--Knowledge about stiles and rails as a basic part of construction practice.

Selected Bibliography:

"Brief Notes on the Subjects of Analyzing Paints and Mortars and the Recording of Moulding Profiles," by Morgan W. Phillips, APT Bulletin, Vol. X, No. 2, 1978, page 77-89.

"Dating Architectural Moulding Profiles -- A Study of 18th and 19th Century Moulding Plane Profiles in New England," by Andrea M. Gilmore, APT Bulletin, Vol. X, No. 2, 1978, page 90-117.

Building Construction and Superintendence by F.E. Kidder, rev. and enlarged by Thomas Nolan, Part II Carpenters' Work, 9th edition rev., New York: 1915. pages 463-483.

"Tools of the Woodworker: Hand Planes," by John I. Rempel, AASLH Technical Leaflet No. 24, "History News," magazine, Vol. 19, No. 12, Oct. 1964.

"Simplified Methods for Reproducing Wood Mouldings," by Gordie Whittington, APT Bulletin, Vol. III, No. 4, 1971, pages 48-53.

The Restoration Manual by Orin M. Bullock, Jr., Norwalk, Connecticut: 1966.

APT Bulletin, Vol. X, No. 4, 1978, entire issue is on "Architectural Mouldings." (Letters on this issue are in APT Bulletin, Vol. XII, No. 1, 1980, pages 4-6.

"Central Pennsylvania Farm House Interiors: 1810-1850," by Richard W. Pencak, APT Bulletin, Vol. XIII, No. 4, 1981, pages 38-42.

"A Plea for the Study of Mouldings and a Review of Some Sources," by Martin E. Weaver, APT Bulletin, Vol. IX, No. 1, 1977, pages 81-84.

You should also consult such 18th century manuals as the Rules for Drawing the Several Parts of Architecture by James Gibbs, London, 2nd edition, 1736; and the variety of 19th century carpenters' and builders' manuals such as Detail, Cottage and Constructive Architecture... by Amos Jackson Bicknell, New York: several editions from 1873 to 1886.

Historic Building Systems--Foundations

Knowledge about historic foundations ranging from simple piers or posts, to masonry foundations, to simple footings, to spread footings, or reverse arches, historic retaining walls.

Basic Level

--Familiarity with engineering and construction treatises of the 19th century.
--Understanding the basic types of foundations, soils as a supporting medium as it relates to soil constituents, moisture content.
--Understand standard and unusual foundation construction systems (such as the reverse arch).
--Be able to correlate applicability of reference materials and records to specific buildings.
--Knowledge of dampproofing courses in foundations.
--Knowledge of parging and pargetting practices.
--Knowledge about different foundation practices such as wood timber on grade, mud sills, straight footings, step footings, continuous foundations, wooden piers, splayed foundations.
--Knowledge about the historic use of concrete for foundations.
--Knowledge about the archeological values of builders' trenches.

Advanced Level

--Knowledge of historic waterfront construction or construction in marshy tidelands, e.g. New Orleans.
--Knowledge about historic piling and cribbing construction.
--Knowledge about underpinning of historic foundations.
--Knowledge about foundations for special building types such as lighthouses and forts.

Master Level

--Knowledge of historic cassions.
--Knowledge of historic modifications to foundations, e.g. Wells Cathedral, or the Washington Monument.

Selected Bibliography:

A Treatise on Civil Engineering by D.H. Mahan, New York: 1875.

"History of Building Foundations in Chicago," by Ralph B. Peck, University of Illinois Bulletin Vol. 45, No. 29: 1/2/1948.

Conservation of Historic Buildings by Bernard M. Feilden; Part I, Chapter 6, "Structural Elements IV: Foundations," London: 1982.

Elements of Civil Engineering... by John Millington, Philadelphia and Richmond: 1839.

Early Connecticut Meetinghouses by J. Frederick Kelly, Vol. 1, pages xl-xli, New York: 1948.

Early Years of Modern Civil Engineering by Kirby Laurson, Yale University Press, 1932.

Building Stone, Foundations, Masonry, by William S. Lownders, International Textbook Company, Scranton, PA 1930.

Foundation Walls for All Classes of Buildings, Pile Driving, Building Stones, and Bricks, Pier and Wall Constuction, Mortars, Limes, Cements, Concretes, Stuccos, Etc. by George T. Powell, William T. Comstock Publisher, 1889.

The Architect, Engineer, and Operatives Builders Construction Manual by Christopher Davy, London Press, 1841.

"The Art of Preparing Foundations for All Kinds of Buildings with Particular Illustrations of the 'Method of Isolated Piers as Followed in Chicago'", by Frederick Baumann, 1873, Reprinted in part, Engineering Experiment Station Bulletin Series No. 373, University of Illinois, 1948.

Healthy Foundations for Houses by Glenn Brown (reprinted from the Sanitary Engineer, a series of articles during the year 1884) Van Nostrand, Published, New York, 1885.

Kidder-Parker Architects' and Builders' Handbook by Frank E. Kidder and Harry Parker, 18th edition, New York: 1945. Includes Chapter II on Foundations by Daniel E. Moran; Chapter III on Masonry Walls, Footings for Light Buildings, Cements and Concretes by Charles M. Gay; and Chapter IV on Retaining-Walls, Breast-Walls, and Vault Walls by Grenville Temple Snelling.

Building Construction and Superintendence by F.E. Kidder, rev. and enlarged by Thomas Nolan, Part I Masons' Work, 9th edition rev., New York: 1914. Includes Chapter 1 on Foundations on Firm Soils; Chapter 2 on Foundations on Compressible Soils; Chapter 3 on Masonry Footings and Foundation Walls, Shoring and Underpinning.

"The Fortresses of Louisbourg and Its Cartographic Evidence," by John Fortier, APT Bulletin, Vol. IV, No. 1/2, 1972, pages 3-40, 109 figures.

International Library of Technology Vol. 30B, on Masonry, Carpentry, Joinery and Steel Square: Scranton: 1909. Sections on "Excavating, Shoring and Piling," "Footings and Foundations", "Areas, Vaults, and Retaining Walls."

"Cemetery Wall Restoration, New Harmony, Indiana," by Thomas J. Kane, APT Bulletin, Vol. IX, No. 3, 1977, pages 39-51.

"Fort Frederick Wall: Analysis and Stabilization," by Ross M. Kimmel, APT Bulletin, Vol. XVI, No. 2, 1984, pages 32-43.

Foundations.. by Jules Gaudard, New York, 1878 and 1891.

Practical Treatise on Foundations... by William MacFarland Patton, New York, 1893.

Ordinary Foundations by Charles Evan Fowler, New York and London, 1905.

Soil Mechanics Related to Buildings by John H.G. King and Derek A. Creswell, Chapter II on Principles of Site Investigations for Building Foundations; Chapter VII on Choice of Foundation; Chapter VIII on Depth of Foundations: Tree Root Action in Clay Soils and Soil Failures; London, 1954.

DM 7.2 Foundation and Earth Structures, available from the U.S. Government Printing Office, Stock Number 008-050-00221-2, price $8.00.

Historic Building Systems--Structures

Knowledge about historic structural systems such as masonry wall bearing construction and various combinations of masonry arches (semi-circular, elliptical, flat arches), vaulted construction (barrel vaults, elliptical vaults, tile vaults, domes, pendentives), cavity wall construction, and vault systems such as iron and terracotta beams and arches. Knowledge about various types of historic wooden framing systems, including regional variations of pegged-braced frames, wooden wall trusses, wooden floor framing systems, wooden roof trusses, roof framing, historic balloon framing, platform framing, etc. Knowledge about prefabrication of wall, floor and roof framing in early buildings and all the assorted connecting devices used for historic wooden structural systems including wooden pegs, nails, bolts, and tie rods. Knowledge about structural systems made of adobe, brick, stone, concrete, wood and steel.

Basic Level

--Familiarity with the historic architectural and civil engineering treatises on building construction, including carpentry.
--Familiarity with scholarly regional treatises on various subjects relating to structural systems, barn and bridge framing, etc.
--Recording and making measured drawings of structural systems, wall framing trusses and vaulting.
--Knowledge of wall bearing composite materials such as iron beams with masonry vaults, arch and lintel systems, floor and roof systems of masonry, steel and wood, beams, trusses and slab, frame and arch systems.
--Framing and trussing in steel or wood or reinforced concrete.
--Knowledge about the development, evolution and application of structural systems in terms of general systems, e.g. wall systems with air openings, floor systems, roof and external surface systems.

Advanced Level

--Knowledge of the evolution and use of unusual building types like Guastavino tile vaults, domes and stairways.
--Ability to use nails and connecting devices as dating "tools"; knowledge about fastening systems and jointing systems.
--Knowledge of unusual systems like rammed earth or adobe bearing walls.
--Sufficient depth of knowledge in order to recognize differences of periods and regional applications of systems in the basic type, for example to know the regional differences between 17th century framing systems, knowledge of plank frame buildings.
--Knowledge of precast prestressed structural members and structural systems other than buildings like bridges, canals, fortifications including casemated forts of the Third System.
--Knowledge about floor framing systems including sawn joists as well as puncheon joists.

Master Level

--The expert or authority on various aspects of structural systems whether masonry or wood, especially regional aspects.
--Ability to teach and publish on this topic.
--Knowledge of regional, ethnic, and short period variations of historic structural systems.
--Knowledge of fastening systems.
--Knowledge of the use of logs sticking in the ground and the effect of deterioration.
--Knowledge of unusual structures like the Statue of Liberty.
--Knowledge of anomaly systems; things that weren't built the way they were supposed to be built.
--Knowledge of the development of historic construction systems for erecting structures including scaffoldings, shoring, cranes, centering, and other temporary erection systems.
--Knowledge of historic prefabricated buildings, e.g. a prefab mission house in Hawaii that was sent from Connecticut.
--Knowledge about sod houses.

Selected Bibliography:

Carpentry Made Easy by William E. Bell, Philadelphia: 1858 (and numerous later editions)

The Framed Houses of Massachusetts Bay, 1625-1725 by Abbott Lowell Cummings, Cambridge, Mass.: 1979

The New World Dutch Barn, a Study of Its Characteristics, Its Structural System, and Its Probable Erection Procedures by John Fitchen, Syracuse, NY: 1968, 1969.

Building With Wood by John I. Rempel, Toronto, 1967

The Rules of Work of the Carpenters' Company of the City and County of Philadelphia 1786 introduction by Charles E. Peterson, Princeton: 1971

American Building by Carl W. Condit, Chicago, 1968.

Building Early America by the Carpenters' Company of the City and County of Philadelphia, Charles E. Peterson editor, Radnor, Pennsylvania: 1976.

Kidder-Parker Architects' and Builders' Handbook by Frank E. Kidder and Harry Parker, 18th edition, New York: 1945. Includes Chapter VIII on The Stability of Masonry Arches by Grenville Temple Snelling; Chapter IX on Reactions and Bending Moments for Beams by Charles P. Warren; Chapter XII on Resistance to Shear, Riveted Joints, Pins and Bolts by Herman Claude Berry; Chapter XIV on Strength of Columns, Posts and Struts by Hardy Cross and F. Theodore Mavis; "Chapter XVI on Strength of Built-Up, Flitched and Trussed Wooden Girders by R.P,. Davis; Chapter XX on Wood Framing by Charles M. Gay; Chapter XXI on Wooden Mill and Warehouse Construction by A.P. Stradling; Chapter XXIV on Types of Roof Trusses by C.E. Palmer; Chapter XXIX on Domical and Vaulted Structures by Edward F. Ries.

Building Construction and Superintendence by F.E. Kidder, rev. and enlarged by Thomas Nolan, Part I Masons' Work, 9th edition rev., New York: 1914. Includes Chapter XI on Iron and Steel Supports for Masonwork-Skeleton Construction.

Building Construction and Superintendence by F.E. Kidder, rev. and enlarged by Thomas Nolan, Part II Carpenters' Work, 9th edition rev., New York: 1915. pages 89-103.

The Building Trades Handbook by International Correspondence Schools, 5th edition, Scranton: 1924.

Seacoast Fortifications of the United States: An Introductory History by Emanuel Raymond Lewis. Washington, D.C.: 1970.

"The Fortresses of Louisbourg and Its Cartographic Evidence," by John Fortier, APT Bulletin, Vol. IV, No. 1/2, 1972, pages 3-40, 109 figures.

Cyclopedia of Architecture, Carpentry and Building Vol. V on Steel Construction, Elevators; Chicago: 1908. Pages 11-314 on Steel Construction.

The Development of Carpentry 1200-1700: An Essex Study by Cecil A. Hewett, Devon, England and New York: 1969. Book Review in APT Bulletin, Vol. III, No. 1, 1971, pages 8-10.

The Barn..., by Eric Arthur and Dudley Witney, Greenwich, CT: 1972.

"Essay on the Theory and History of Cohesive Construction Applied Especially to the Timbrel Vault," by Rafael Guastavino, Boston: 1892, 1893. (Book Review in American Architect and Building News, Vol. 52, pages 94-95, June 6, 1896.)

"The Transfer of Thin Masonry Vaulting from Spain to America," by George R. Collins, Journal of the Society of Architectural Historians, Vol. 27, No. 3, pages 176-201, October 1968, illus., plan.

"The Principles of Dome Construction," by William Dunn, Architectural Review, Vol. 23, pages 63-73, Jan. 1908, pages 108-112, Feb. 1908, illus., plan.

"A Comparative Historical Study of Timber Building in Canada," by A.J.H. Richardson, APT Bulletin, Vol. V, No. 3, 1973, pages 77-102.

"A Selected Annotated Bibliography for the Study of Newfoundland Vertical-Log Structures with Some Comments on Terminology," by Shane O'Dea, APT Bulletin, Vol. XIII, No. 1, 1981, pages 35-37.

"Boulderberg: A Neo-Gothic House of Poured Concrete," by Theodore H. M. Prudon, APT Bulletin, Vol. V, No. 4, 1973, pages 28-39.

"Notes on the History of Hollow Masonry Walls," by T. Ritchie, APT Bulletin, Vol. V, No. 4, 1973, pages 40-49.

"Stone Pre-Fab in Quebec City in the Middle of the Eighteenth Century," by A.J.H. Richardson, APT Bulletin, Vol. V, No. 4, 1973, pages 73-75.

"Sod Houses in Nebraska," by Tim Turner, APT Bulletin, Vol. VII, No. 4, 1975, page 20.

"Plywood Reinforcement for Structural Wood Members with Internal Defects," by T. Szabo, APT Bulletin, Vol. IX, No. 1, 1977, pages 11-15.

"Inventing the I-Beam: Richard Turner, Cooper and Hewitt and others," by Charles E. Peterson, APT Bulletin, Vol. XII, No. 4, 1980, pages 3-28.

"The Town Lattice Truss in Building Construction," by Harvie P. Jones, APT Bulletin, Vol. XV, No. 3, 1983, pages 39-41.

"..To Strengthen the Girder.." by Robert DeSilets, APT Bulletin, Vol. V, No. 1, 1973, pages 50-57.

Early Connecticut Meetinghouses by J. Frederick Kelly, 2 Vol., pages xli-xliv, and page xlviii, also has sketches of 82 roof trusses.

Building in Wood in the Eastern United States by Henry Glassie and Fred Kniffen, American Geographical Society, New York: 1966. (Excerpt from Geographical Review, Vol. 56, No. 1, 1966, pages 40-66.)

"In Delorme's Manner...", by Douglas Harnsberger, APT Bulletin, Vol. XIII, No. 4, 1981, page 3. (On the use of X-ray.)

Historic Building Systems--Wall Cladding

Knowledge about historic exterior wall surfaces and materials including various forms of wooden siding, clapboards, shingles, shakes, board and batten systems, metal sheeting. Knowledge of the various craft practices used to fabricate and/or install these materials in various times and locales ranging from hand-splitting to machine made, from hand attached in various ways to fairly sophisticated attaching techniques. Knowledge about the craftsmanship and materials used to make historic walls to be able to repair, piece out, or replace damaged or deteriorated siding materials; to be able to estimate the damage to such covered materials as a result of energy retrofitting of frame walls or the introduction of high humidity in the building system.

Basic Level

--Knowledge of the general evolution, manufacturing and application of wall cladding systems such as board and batten systems.
--Knowledge of the use of substitute materials to imitate other materials, such as metal sheeting to look like brick, asphaltic materials, shingles, corrugated iron.
--Knowledge about curtain wall composite materials like architectural concrete, metal panels systems, panels with ceramic facing, masonry veneers on wooden framing systems.

Advanced Level

--Knowledge of the "oddball" cladding, or of temporary cladding materials like tar paper, grasses and barks, for example the Thomas Edison Black Moriah.
--Knowledge of the surface textures of cladding materials; the manufacturing and profile differences as they define periods, e.g. German siding, pebble dash on precast panels.
--Knowledge about curtain wall materials such as cast iron.
--Knowledge of sources of replacement or replicative parts.
--Ability to repair and replicate cladding materials.

Master Level

--Knowledge of sources of manufacturing materials.
--Knowledge of anomalies of place and period.

Selected Bibliography:

Metals in America's Historic Buildings by Margot Gayle, David W. Look, John G. Waite, Washington, D.C. 1980.

Architectural Elements, The Technological Revolution Edited by Diana S. Waite, Princeton, 1973.

Building with Wood by John I. Rempel, Toronto: 1967.

The Grand Era of Cast-Iron Architecture in Portland by William John Hawkins III, Portland, Oregon: 1976.

The 1905 Catalogue of Iron Store Fronts Designed and Manufactured by Geo. L. Mesker & Co., Architectural Iron Works, Evansville, Indiana reprinted in APT Bulletin, Vol. IX, No. 4, 1977, pages 3-40.

"Cast Iron In American Architecture: A Synoptic View" by Antoinette J. Lee, The Technology of Historic American Buildings edited by H. Ward Jandl, Washington , D.C. 1983.

Building Construction and Superintendence by F.E. Kidder, rev. and enlarged by Thomas Nolan, Part II Carpenters' Work, 9th edition rev., New York: 1915. pages 299-304.

"Prefabs in the California Gold Rush, 1849," by Charles E. Peterson, Society of Architectural Historians Journal, Vol. 24, No. 4, pages 318-324, Dec. 1965, illus., plan.

"Pioneer Prefabrication in Honolulu," by Charles E. Peterson, AIA Journal, Sept. 1973, page 42.

Vol. 31, International Library of Technology by the International Textbook Company covers Stair Building, Ornamental Ironwork, Roofing, Sheet-Metal Work, Building Superintendence, Contracts and Permits; the section on Sheet-Metal Work is particularly relevant; New York: 1903.

Pioneers of Prefabrication: The British Contribution in the Nineteenth Century by Gilbert Herbert, Baltimore: 1978. (Book Review in APT Bulletin, Vol. XII, No. 2, 1980, pages 133-134.)

"The Molded Brick Cornice in the Valley of Virginia," by Pamela H. Simpson, APT Bulletin, Vol. XII, No. 4, 1980, pages 29-33.

Conservation of Historic Buildings, by Bernard M. Feilden, London: 1982.

Historic Building Systems—Roofs

Knowledge about historic roof covering materials such as ceramic tile, slate, thatch, composition, boarding, and wooden shingling in a wide range of materials and craftsmanship (split, side-lapped, sawn, shaped, face-nailed, etc.). Knowledge about shingling practices at ridges, hips, valleys, chimneys and dormers. Knowledge about the great variety of metal roofing materials such as tin, copper, lead, iron and zinc. Knowledge about historic flat roofing systems with built in rain water disposal. Knowledge about historic flashing and contemporary flashing details to be able to solve problems around dormers, vents, skylights, chimneys, turrets, and other complex roof features.

Basic Level

--Evolution and development of roofing systems such as wood, metal and slate.
--Knowledge about all the basic wood shingling materials like red cedar, white cedar, oak, cypress, locust, chestnut, white pine. Knowledge about regional preferences and availabiilty; about practices by which shingles were made ranging from handcraft to machinemade.
--Fastening systems for roofs the method of hanging and nailing slate, method of fabricating, clipping and fastening metals, flat seams, and standing seams.
--Sheathing systems such as solid sheathing, roof lath or roofers, beveled sheathing.
--Knowledge of tin, copper, lead, zinc, and iron used as roofing materials.
--Knowledge about the use of flashing, and the materials used in flashing including cant strips for intersections at bulks, party walls, dormers.
--Knowledge about built-in downspouts and other water disposal systems.

Advanced Level

--Knowledge about built in pole gutters, drainage and the intersection and edge systems including valleys, hips, gables, ridges.
--Roofs made of composition materials like asphalt and asbestos.
--Knowledge of rainwater collection and disposal systems like rain conductor heads.
--Sheet metal pantile material, embossed sheet metal and embossed tin to imitate wood or tile.
--Knowledge about the use of tiles, such as Pennsylvania German tile roofs with hooks, Spanish tile roofs, Dutch tile roofs in New York.
--Knowledge about fastening and materials and flashing details and systems, lead flashing over frontispiece pediments.
--Board roofs both vertical and parallel, split out of wood and cut out of wood.
--Knowledge of wood shingling beyond an individual region; knowledge about the broad differences that took place over a period of time -- differences in flashing details, starting courses, ridges, eaves, valleys, and nailing practices.
--Practices using interlayers e.g. papers, tar felts, canvas, interlayers in metal roofs.
--Knowledge of the practices in using tin, copper, lead, zinc, and iron, such as herringbone tin roofing practices.

Master Level

--New research on uses of roofing materials and craft practices in regions.
--Awareness of fabric in built up roofs e.g. canvas and tar in 1850's.
--Temporary materials such as thatching and bark and the history of built up roofs, sod roofs.
--Roofing coatings including tar, paint, red iron oxide, linseed oil and brick dust, sanded paints, creosote.
--Unusual systems that did not endure such as the herringbone metal shingles. Practices that were identified with areas or ethnic groups that did not prevail for any length of time.
--Knowledge of ethnic or national practices that may be followed in the United States in limited areas, such as French roofing systems, Ludovici Interlocking Spanish Tile roofs in the 1920's, roofs of the Southwest.
--Knowledge of roofing's special shapes such as steeples, cupolas, towers, and domes.
--Knowledge of special finishes such as gilding, glazed tiles, ceramic metals.

Advanced continued

--Roof appendages such as hatches, roof ladders, roof decks, lightning rods, snow guards of bent wire and cast iron.

--Knowledge of roof cresting both in sheet metal and cast metal under the snow guards. Knowledge of roof balustrades and their connections and flashing. Knowledge of unusual penetrations and connections and the additions of later mechanical equipment. Knowledge of skylights and flashing problems.

--Roofing for special kinds of buildings like lighthouses and churches.

--Knowledge of built up and composition roofs used from the late 1860's including canvas roofs and canvas walking decks.

--Concrete and other materials used as a substrate for composition roofs.

--Knowledge about stone roofs such as Grants Tomb, Federal Hall, Jefferson Memorial.

Selected Bibliography:

"Terra Cotta: Rehabilitation of a Courthouse Dome," by A. Richard Glance, APT Bulletin, Vol. XVII, No. 1, 1985, pages 38-45.

"Bibliography for Slate Roofing," compiled by Ms. Gouhar Shemdin, APT Newsletter, Vol. IV, No. II, April 1975, pages 8-9.

Sections on "Roofing" and "Sheet-Metal Work," Vol. III of A Treatise on Architecture and Building Construction International Correspondence Schools, Scranton, Pennsylvania: 1899.

"The Work of Benjamin Franklin on Thunderstorms and the Development of the Lightning Rod," by B.F.J. Schonland, pages 375-392; "Prejudice Against the Introduction of Lightning Rods," by I. Bernard Cohen, pages 393-440; "Lightning Protection Since Franklin's Day," by K.B. McEachron, pages 471-504; in Journal of the Franklin Institute, Vol. 253, No. 5, May 1952.

"Polychromatic Roofing Slate of Vermont and New York," by Philip C. Marshall, APT Bulletin, Vol. XI, No. 3, 1979, pages 77-87.

"A Preliminary Study of 'English' Roofs in Colonial America," by D.T. Yeomans, APT Bulletin, Vol. XIII, No. 4, 1981, pages 9-18.

"Early Roofing Materials," APT Bulletin, Vol. II, No. 1/2, 1970, pages 18-87.

Architectural Graphic Standards by Charles George Ramsey and Harold Reeve Sleeper, New York and London, first edition 1932, second edition 1936, third edition 1941.

International Library of Technology Vol. 31 covers Stair Building, Ornamental Ironwork, Roofing, Sheet-Metal Work, Building Superintendence, Contracts and Permits, by International Textbook Company, New York: 1903. "Memoranda on Roofing," pages 1994-2020.

Nineteenth Century Tin Roofing and Its Use at Hyde Hall by Diana S. Waite, Albany: 1971.

"Roofing for Early America," by Diana S. Waite in Building Early America, Radnor, Pennsylvania: 1976.

The Framed Houses of Massachusetts Bay, 1625-1725 by Abbott Lowell Cummings, Cambridge, Mass.: 1979

Building Construction and Superintendence by F.E. Kidder, rev. and enlarged by Thomas Nolan, Part II Carpenters' Work, 9th edition rev., New York: 1915. pages 143-161, 250-299, 315-357.

"Item on Roofing in Nineteenth Century" contributed by Philip Shackelton, APT Bulletin, Vol. VI, No. 3, 1974, pages 148-149.

"Wooden Forts of the Early Northwest: Fort William," by Joan Halloran, APT Bulletin, Vol. VI, No. 2, 1974, pages 39-81.

"Board Roofing in Tidewater Virginia," by Dell Upton, APT Bulletin, Vol. VIII, No. 4, 1976, pages 22-43.

"A Further Note on French-Canadian Roof-Cover and Timber Walls," by A.J.H. Richardson, APT Bulletin, Vol. VIII, No. 1, 1976, pages 61-69.

"Notes on Thatch and Sod Roofing," by Martin E. Weaver, APT Bulletin, Vol. VIII, No. 1, 1976, pages 70-71.

"Sod Houses in Nebraska," by Tim Turner, APT Bulletin, Vol. VII, No. 4, 1975, pages 20-37.

"A Surviving Eighteenth Century Copper Roof," by Sarah Sweetser, APT Bulletin, Vol. IX, No. 2, 1977, pages 10-15.

"Roof Thatching Methods in Crockett County, Texas," by Andrea Holman, APT Bulletin, Vol. IX, No. 2, 1977, pages 16-31.

Conservation of Historic Buildings, by Bernard M. Feilden, London: 1982.

"Establishing a Platform...Strategic Maneuvers for Restoration Work," Technology and Conservation, Vol. 7, No. 1, Spring 1982, pages 5-8. (Re scaffolding for a dome.)

"Iron in Early American Roofs," by Charles E. Peterson, Smithsonian Journal of History, Vol. 3, No. 4, Fall 1968, pages 41-76.

On the Construction of Iron Roofs by Francis Campin, New York: 1868.

The Houses of French St. Louis by Charles E. Peterson, reprinted from The French in the Mississippi Valley edited by John Francis McDermott, Urbana, IL: 1965.

Historic Building Systems--Windows

Knowledge about historic window systems: single hung, double hung, and casement systems with sash, frames, weights and/or associated hardware. Knowledge about the evolution of muntin profiles. Knowledge about historic glass types, such as crown glass, broad glass; their physical characteristics, thickness, color and visual qualities due to their manufacturing processes; later glass products, such as plate glass, beveled glass, etched glass, decorative glass, stained glass, modern glass, structural glass, glass block. Knowledge about metal sash systems and their historical development.

Basic Level

--General knowledge of all the basic historic window systems including 17th century wood and metal casement windows, wooden single hung and double hung window systems from 1700 to the present, with all their variants for residential, commercial and public buildings.
--Knowledge of basic glass types in historic American buildings including crown, broad, and plate.
--Ability to identify the glass types by their physical characteristics to use that as a dating tool and to help discern the physical evolution of the building to assure the preservation of early glass.

Advanced Level

--Knowledge of glass types such as beveled plate art glass, leaded art glass, wire glass, structural glass, glass block, prism glass and etched glass. Knowledge of theatrically antique reproduction glass and understanding of its inappropriateness for use in historic structures.
--Ability to identify glass that has been affected by chemical attack to be able to identify problems and seek qualified conservation assistance.
--Knowledge of metal sash systems both the industrial types commonly used in commercial and warehouse buldings as well as the more architecturally distinctive metal sash used in elegant domestic buildings, Art Moderne, and public buildings of the early 20th century.
--Knowledge of lead caming and associated hardware such as the hinges, latches, and reinforcement bars or wood muntins to be able to sort out the different periods.
--Ability to specify various types of glass regarding the needed optical quality for use in historic buildings and regarding the life and safety code requirements for use in historic storefronts.

Master Level

--Expert on the subtle variations of early casement window systems, especially the regional uses.
--Identification of lead glazing strips for casement windows by their glaziers marks.
--Knowledge about false windows.

Selected Bibliography:

Glass in Architecture and Decoration by Raymond McGrath, London, 1937.

Glass, Paints, Varnishes, and Brushes by Pittsburgh Plate Glass Company, Pittsburgh, PA: 1923.

The Restoration Manual by Orin M. Bullock, Norwalk, Connecticut: 1966, page 77 on muntin profiles.

"Preservation Briefs: 9, The Repair of Historic Wooden Windows," by John H. Myers, Washington, D.C.: 1981.

"Preservation Briefs: 13, The Repair and Thermal Upgrading of Historic Steel Windows," by Sharon C. Park, AIA, Washington, D.C.: 1984.

"Fixing Double-Hung Windows," Old House Journal, No. 12, 1979, page 135.

"Sealing Leaky Windows," Old House Journal, No. 1, 1973, page 5.

Hope's Leadwork by Henry Hope, New York, 1917.

ASHRAE Handbook - 1977 Fundamentals American Society of Heating, Refrigerating and Airconditioning Engineers, New York: 1978.

A Metal Window Dictionary by W.F. Crittal, London: 1926; reprinted by B.T. Batsford, Ltd., 1953.

Metals in America's Historic Buildings by Margot Gayle, David W. Look, John G. Waite, Washington, D.C.: 1980.

"Selecting and Specifying an Appropriate Type of Steel Window," by R.H. Sarton, Metalcraft, Vol. 6, No. 1, January 1931: pages 43-48, 64-65.

1910 Handy Pocket Size Edition Illustrated Catalogue Containing Our Complete Line of Crown and Front Doors Cottage Windows Art Glass Porch and Stair Work Material and All Specialties Also the Official Price List on Sash, Doors, and Blinds as Adopted Jan. 24, 1908 by the Whole Sale Sash, Door and Blind Manufacturers' Association of the Northwest and the New Revised Universal Moulding List as Adopted Oct. 14, 1908 by Rock Island Sash and Door Works, Rock Island, Illinois: 1910 edition. Illustrated Catalog No. 120.

Building Construction and Superintendence by F.E. Kidder, rev. and enlarged by Thomas Nolan, Part II Carpenters' Work, 9th edition rev., New York: 1915. Pages 169-220, 229-238, 410-431, 627-654

A Guide to Artifacts of Colonial America by Ivor Noel Hume. Pages 233-235 on broad and crown glass.

"Window Glass in America," by Kenneth M. Wilson, in Building Early America, edited by Charles E. Peterson, Radnor, Pennsylvania: 1976.

"Monongahela and Pittsburgh District Glass: 19th Century," by Ronald L. Michael and Ronald C. Carlisle, APT Bulletin, Vol. VII, No. 1, 1975, pages 57-85.

"The Incidence of False Windows in Two Early Newfoundland Lighthouses," by R.M. Peck, APT Bulletin, Vol. IX, No. 1, 1977, pages 4-10.

"A Short Note on an Early Sash Window Found at East Hampton, Long Island," by Martin E. Weaver, APT Bulletin, Vol. X, No. 1, 1978, pages 54-62.

"18th Century Black Window Glazing in Philadelphia," by Frank S. Welsh, APT Bulletin, Vol. XII, No. 2, 1980, pages 122-123.

APT Bulletin, Vol. XIII, No. 3, 1981, the entire issue is on "Architectural Glass: History and Conservation."

"Documentation of Stained Glass Window Restoration," by Julie L. Sloan, APT Bulletin, Vol. XV, No. 1, 1983, pages 12-19.

"A Technical History of Late Nineteenth Century Windows in the United States," by Susan Swiatosz, APT Bulletin, Vol. XVII, No. 1, 1985, pages 31-37.

"A Fitting Solution ...for On-Site Window Restoration," Technology and Conservation, Vol. 8, No. 3, Fall 1983, pages 5-8.

"Reconstruction of the Lockwood-Mathews Mansion Museum Conservatory," by Richard Bergmann, APT Bulletin, Vol. XIV, No. 3, 1982, pages 2-6.

Historic Building Systems--Flooring

Knowledge about historic flooring materials and floor coverings from the whole spectrum of early wooden flooring: pegged, face-nailed, blind-nailed, butt joints, tongue and groove, random widths, matched widths. Knowledge about the hierarchy of floor treatments relative to the social importance of the space. Knowledge about historic floor finishes, early flooring maintenance practices, knowledge about later hardwood flooring, parquet and decorative flooring. Knowledge about historic tile, marble, and other stone and/or brick flooring. Knowledge about historic floor coverings such as carpets, painted floor cloths, linoleum.

Basic Level

--Knowledge of brick flooring and pavements in their variety of patterns, e.g. basketweave.
--Knowledge of stone floors such as slate and plain marble and patterned marble.
--Knowledge about floor finishes such as paints, varnishes, decorative painting.
--Knowledge about baseboards and painting practices.
--Knowledge of the manufacturing of flooring (all materials) ranging from handcrafts to the machine made to aid in dating and to aid in specifying replacement materials for example, for wood, pit sawn, sash sawn, circular sawn; hand planing and machine planing the exposed surfaces and hand work vs. machine work for tongue and grooving.

Advanced Level

--Knowledge of glass prisms for flooring and sidewalks. Knowledge of Minton's tiles for floors and pavements.
--Knowledge of mosaic and terrazo, floor cloths, linoleum, asphalt tile, sheet cork, cork tile, parquet floors, earth floors.
--Knowledge about concrete floors. Knowledge about subfloors, sound-deadening materials such as felt or quilt, and subflooring systems.
--Knowledge and familiarity with species of woods used for flooring regionally and ethnically; knowledge about the fastening techniques for attaching these woods.
--Knowledge of the qualities of woods used for flooring to be able to specify for repair or replacement, e.g. riff grain or quarter sawn.
--Knowledge about the development of hardwood flooring industry.
--Knowledge about wedging and relieving floor boards.

Master Level

--Knowledge of mud floors and dirt floors and the regional and other differences between the two.
--Knowledge of history and development of grading rules.
--Knowledge of laying and nailing of flooring including variations of nailing practices, tongue and grooved, end-matched grains to help prevent squeaking, vertically pegged and horizontally pegged.
--Knowledge about special kinds of flooring such as bowled floors, or gallery floors for theatres or churches.
--Ability to work with manufacturers to replicate historic flooring materials or lost craft or manufacturing techniques.

Selected Bibliography:

Building Construction and Superintendence by F.E. Kidder, rev. and enlarged by Thomas Nolan, Part II Carpenters' Work, 9th edition rev., New York: 1915. pages 103-131, 340-363, 668-682, 704-708.

Ancient Carpenters' Tools by Henry Chapman Mercer, 3rd edition, Doylestown, PA: 1960.

The Architecture of Country Houses by A. J. Downing, New York: several editions from 1850 to 1866; reprinted New York: 1968, 1969.

"A Brief History of Mosaic Floors and Terrazzo Work," The Art of Mosaics and Terrazzo, (magazine), February and March 1931, Vol. II, No. 2, and Vol. II, No. 3.

Modern Mosaic and Terrazzo Floor by L. Del Tusco and Bros., Inc. Harrison, New York: 1924.

The Rules of Work of the Carpenters' Company of the City and County of Philadelphia 1786 pages 10-11, reprinted Princeton, NJ: 1971.

"'Sand-Board' Usage Under Floor of an Early House in Tuckerton, New Jersey," by Henry O. Tuslin, APT Bulletin, Vol. V, No. 1, 1973, pages 102-103.

"Nineteenth Century Architectural Insulation: Zoar, Ohio," by J.M. Gaynor, APT Bulletin, Vol. VIII, No. 4, 1976, page 100-112.

"Deafening: An Early Form of Sound Insulation," by Theodore H.M. Prudon, APT Bulletin, Vol. VII, No. 4, 1975, pages 5-13.

Analysis and Treatments--Wood

Knowledge about evaluating the whole range of wood preservation problems including poor original materials, poor original workmanship, damage due to neglect, overstress, high humidity and moisture problems, insect attack, deterioration of joints and connecting devices, embrittlement. Knowledge about techniques for treating and stabilizing dry rot in historic wood including understanding the mechanisms of fungal decay to be able to identify in the early stages the several types of fungal decay and how to treat. Knowledge about the various fungicides, their appropriateness and their hazards. Knowledge about dealing with insect infestations and damage.

Knowledge about the structural repair and reinforcement of historic wood and knowledge about wood epoxy reinforcement (WER) systems. Knowledge about various physical and chemical repairs, reinforcement, treatments such as piecing out with new materials in kind, splicing with dissimilar materials. Knowledge about the various systems for wood epoxy reinforcement, including knowledge about how to formulate appropriate epoxy consolidants with an understanding of the various kinds of resins, curing agents and extenders and methods of application of stabilizers alone or in combination with wood patching to assure workability for decorative members and fragile parts such as window muntins that such consolidation, repair and patching methodologies should respect the original materials in terms of strength, expansion and contraction and visual characteristics.

Knowledge about general woodworking and millwork practices such as the appropriate use of other woods and substitute materials where original species or other qualities of the wood are no longer available. Knowledge about the appropriateness of hand tools vs. machine tools including sanding, back priming, the effects of various chemical treatments including fire retardant chemicals. Knowledge about how to reproduce historic wooden moldings.

Basic Level

--Knowledge about the processes of deterioration, knowledge about insect attack of wood and the more common insects in the region.
--Recognizing simple problems of poor detailing and poor materials.
--Ability to select wood for species, density and cut.
--Ability to inspect both wood and workmanship in new construction.
--Knowledge about modern woods as substitutes for historic woods where texture and grain are not important. Knowledge about the durability of modern woods for interior or exterior uses, for example, inappropriateness of using Western white woods for window sash.
--Understanding of basic grading rules, for example, hemlock and pine are often graded the same yet they perform very differently.

Advanced Level

--Knowledge of ultraviolet degradation of wood.
--Ability to specify and carry out the reinforcement of structural systems by "sharing" a load with system members or posts. Knowledge of the use of shearpins to transfer loads.
--Understanding the use of epoxies for structural reinforcement.
--Knowledge about the problems with historic treatments such as the use of mercury as a wood preservative and the health hazards of working with such wood.
--Ability to specify and supervise the usage of fire retardants. Ability to inspect wood that has been delivered to determine if the specified retardant was in fact applied.
--Ability to supervise millworker or day labor force in how moldings are made, how blades are ground, etc.

Master Level

--Ability to use epoxies intelligently, ability to formulate them, ability to specify their use, ability to supervise their application and use.
--Ability to make your own molding planes.
--Expanded knowledge of the process beyond regional practices for example, knowledge about the effect of ultraviolet light at high elevations or knowledge about unusual insects and their infestation of wood.
--Knowledge about the joining of dissimilar materials.
--Knowledge about the problems associated with the pressure treatment of heavy timbers such as 12" x 12".
--Ability to apply wood gas injection systems.
--Ability to recognize poor conditions for wood and ability to evaluate whether the impact will be serious and immediate or may be deferred.

Basic Level continued

--Knowledge about fungal decay and dry rot, for example if wood is above 20% moisture content it is susceptible to dry rot, fungal decay and insect infestation.
--Basic understanding of reinforcing structural systems by "sharing" a load with system members or posts.
--Knowledge about how to improve the geometry by enlarging the bearing plate or by enlarging the footing.
--Knowledge about all the options for improving the structural systems such as by "sharing" or spreading the load or changing the geometry.
--Knowledge about chemical treatments and basic chemical preservatives and the pros and cons of the use of different fire retardants.
--Full knowledge about Integrated Pest Management Systems including the health hazards associated with the pest control techniques.
--Ability to distinguish between wood that has been worked with machine tools and that worked with hand tools.
--Knowledge about the replication of historic wooden moldings to be aware that the manufacturing process has changed, that going from a sketched profile to a finishing molding is not a simple process, to know how it is accomplished whether by hand or machine, to be able to write specifications for moldings.
--Knowledge about wood repair and replacement, such as replacing rafter tips either with splicing, in kind or with a substitute material. Knowledge about the wrong way to address the problem, that is, "chainsaw maintenance" of rafter tips, to be able to specify the correct methods in work orders.
--Knowledge about the methods, materials and practices of using paints, like back priming of wood; varnishes and coatings like water repellent coatings on bare wood or water repellent coatings prior to painting.

Advanced Level continued

--Understanding the fumigation process and the associated hazards, for example such practices are standard in the South and in Hawaii.
--Knowledge about the fumigation of wood preservation systems such as the use of wood gas injection systems.
--Knowledge about the different types of log buildings; knowledge about the difference between daubing and chinking.
--Ability to specify and apply substitute materials such as metal or fiberglass in place of wood cornices when appropriate.
--Knowledge about non-destructive fabric investigation techniques such as the use of a broom to sweep out the structure, the use of raking light, the use of wiping the surface of wood floors with water, the use of infrared light and infrared photography, the use of X-ray photographs, the use of cameras with fiber optic lights and lenses.
--General knowledge about the usefulness and appropriateness of such non-destructive testing options as acoustic emission sensors, electrical potential measurements, endoscope, gamma radiography, moisture meter devices, penetration probes, ultrasonics etc.

Selected Bibliography:

Epoxies for Wood Repairs in Historic Buildings by Morgan W. Phillips and Judith E. Selwyn, Washington, D.C.: 1978.

Architectural Woodwork Quality Standards by Architectural Woodwork Institute, Arlington, Virginia.

"The Role of Fumigants in Log Preservation," by Robert D. Graham, APT Bulletin, Vol. XV, No. 1, 1983, pages 20-21.

"The Preservation of Logs and Heavy Timbers in Historic Buildings by Using Volatile Chemicals," by Alfred M. Staehli, APT Bulletin, Vol. XV, No. 1, 1983, pages 22-26.

W.E.R. -- System Manual Structural Rehabilitation of Deteriorated Timber by Paul Stumes, Ottawa, Canada: 1979.

"The Effect of Ageing on the Mechanical Properties of Eastern White Pine," by G. Attar-Hassan, APT Bulletin, Vol. VIII, No. 3, 1976, pages 64-73.

"Testing the Efficiency of Wood Epoxy Reinforcement Systems," by Paul Stumes, APT Bulletin, Vol. VII, No. 3, 1975, pages 2-35.

"A Correction for the Article: Testing the Efficiency of Wood Epoxy Reinforcement Systems," APT Bulletin, Vol. VIII, No. 3, 1976, pages 1-2.

Conservation of Wooden Objects published by International Institute for Conservation of Historic and Artistic Works (IIC), second edition, Vol. 2, London: 1971.

"Wooden Structural Members: Some Recent European Preservation Methods," by Theodore H. M. Prudon, APT Bulletin, Vol. VII, No. 1, 1975, pages 4-11.

Guide to Wood Species Selection, Including Sawing Methods, Treatment and Finishing by Architectural Woodwork Institute, Arlington, Virginia: 1968.

Quality Standards of the Architectural Woodwork Industry by Architectural Woodwork Institute, Chicago, 1961; Nashville, Tennessee, 1963.

"Plywood Reinforcement for Structural Wood Members with Internal Defects," by T. Szabo, APT Bulletin, Vol. IX, No. 1, 1977, pages 11-15.

"In-Situ Injection of Wood Preservatives," by Theodore H. M. Prudon, APT Bulletin, Vol. XI, No. 1, 1979, pages 75-80.

American Institute of Timber Construction Source Materials by American Institute of Timber Construction, Washington, D.C.: 1960.

Timber Construction Manual by American Institute of Timber Construction, New York, 1966, 1974.

Wood Structures by American Society of Civil Engineers, New York, 1975.

Wood and Its Uses by P.B. Eassie, Gloucester, 1874.

Architecture in Wood by Hans Jurgen Hansen, New York, 1971.

Timber Engineers' Handbook edited by Howard James Hansen, New York, 1948.

Strength of Beams, Floors and Roofs by Frank Eugene Kidder, New York 1905.

"Simple Remedial Treatment of Deteriorated Wood in Heritage Homes," by T. Szabo and J.K. Shields, APT Bulletin, Vol. XI, No. 2, 1979, pages 17-22.

"X-Ray Investigation of Buildings," by David M. Hart, APT Bulletin, Vol. V, No. 1, 1973, pages 9-21.

"X-Ray Analysis of the Narbonne House," by David M. Hart, APT Bulletin, Vol. VI, No. 1, 1974, pages 78-98.

"Nondestructive Testing for Heritage Structures," by Susan Hum-Hartley, APT Bulletin, Vol. X, No. 3, 1978, pages 4-20.

Nondestructive Testing Handbook edited by Robert C. McMaster, New York, 1973(?)

"Scaled-Rectified Photography on Site," by William B. Hockey, APT Bulletin, Vol. VII, No. 3, 1975, pages 37-78.

"The Use of a Technical Model as a Design Control Aid," by Richard Fairweather, APT Bulletin, Vol. IX, No. 1, 1977, pages 22-29.

"Structural Conservation of the Buildings of Old Fort William, Thunder Bay, Ontario," by Martin E. Weaver, APT Bulletin, Vol. X, No. 3, 1978, page 21-32.

Analysis and Treatments--Masonry

Knowledge about various preservation treatments for historic brick and stone masonry to deal with such problems as spalling, graffiti, crumbling, moisture movement such as rising damp, efflorescence, staining, cracking and detachment. Such treatments range from partial replacement, plastic repair, mechanical attachment devices, chemical consolidation, coatings, damp proofing methodologies and poulticing. Knowledge about monitoring moisture both externally and internally within building materials and within wall systems, analyzing the effects of dissolved salts, sulfates, and nitrates as a result of moisture migration; diagnosing maintenance practices that are contributing to materials or systems deterioration; identifying inherent weaknesses in materials and systems; identifying natural agents of deterioration; identifying built-in design flaws, human changes, alterations, or interventions that are contributing to materials and systems deterioration.

Basic Level

--Broad understanding of the process of deterioration. Knowledge about the process of such problems as moisture, rising damp, efflorescence and subflorescence; knowledge about the problems of inappropriate preservation treatments such as coatings or too hard pointing.
--Ability to explore options for stone repair including the use of substitute materials when acceptable.
--Knowledge about stone deterioration to be able to determine when the "illness" is "terminal", as in powdery brick or delaminating sandstone.
--Ability to write specifications for brick or stone so that it will have similar characteristics to the original material.
--Ability to diagnose the whole range of masonry problems.
--Knowledge about graffiti removal.
--General knowledge about anchoring systems.
--General knowledge about chemical consolidation.
--General knowledge about dampproofing methods and the use of chemical injections including the pros and cons of each.
--Knowledge about the process of deterioration and the basic repair of concrete. (Note: Treatment of Concrete will be addressed in a future expansion of these Selected Skills.)

Advanced Level

--Knowledge about the chemistry of stone as a building material.
--Knowledge about where to find replacement brick or stone, knowledge about closed quarries, opening quarries, exploring and testing options.
--Knowledge about individual kinds of graffiti on special substrate such as on brittle surfaces or with soft substrate.
--Expanded knowledge of anchoring systems. Ability to diagnose, repair and replace anchoring systems.
--Knowledge about how chemical consolidation work is done, knowledge about the new methods being developed or tested such as the use of silane or Breathane, knowledge about the health and other hazards associated with these chemicals.
--Ability to specify and apply dampproofing methods and chemical injections.
--Knowledge about the use of substitute materials in lieu of masonry; ability to weigh the impact of such a substitution on the historic character of the structure; when determined appropriate, ability to specify and supervise the usage of such materials, as for example the use of fiberglass instead of stone on the cornice of the San Francisco Mint.

Master Level

--Ability to try out different mortar mixes.
--Ability to solve both physical and aesthetic problems.
--Ability to deal with the aesthetic problems of concrete repairs. (Note: Treatments for Concrete will be addressed in a future Selected Skill.)
--Knowledge of the problems with taping and surface coating pointing. Knowledge about the pros and cons of other methods.
--Ability specify and formulate repair and replacement of stucco and its various attachment systems.

Basic Level continued

--Knowledge about the basic performance and problems associated with the use of sealants and caulks.
--Knowledge about the materials and practices of using paints on masonry including paint removal before repainting.
--Knowledge about water proof coatings and consolidants.

Advanced Level continued

--Ability to differentiate between when and how to use sealants and caulks in relation to the effect they have on the historic materials, their effectiveness.
--Understanding the design problems in using sealants in terms of the geometry of the building.
--Knowledge about the removal of unusual coatings from masonry, for example cementitious paints.
--Ability to review and evaluate the claims of various paint, coating and other product manufacturers to be able to specify and test the most appropriate coating or to be able to have it formulated if it is not readily available.
--Knowledge about how to specify the coatings, how to detail them and how to apply them.
--Knowledge about non-destructive fabric investigation techniques such as the use of a broom to sweep out the structure, the use of raking light, the use of cameras with fiber optic lights and lenses.
--General knowledge about the usefulness and appropriateness of such non-destructive testing options as acoustic emission sensors, electrical potential measurements, endoscope, gamma radiography, moisture meter devices, penetration probes, ultrasonics etc.

Selected Bibliography:

Conservation of Historic Buildings, by Bernard M. Feilden, London: 1982.

Stone Decay and Conservation: Atmospheric Pollution, Cleaning, Consolidation and Protecting by G. G. Amoroso and V. Fassina, New York: 1983.

"Bibliography for Conservation of Masonry," compiled by Theodore H.M. Prudon, APT Newsletter, Vol. IV, No. II, April 1975, pages 10-12.

"The Geologist's Role in Stone Preservation and Restoration," by Erhard M Winkler, APT Bulletin, Vol. XV, No. 3, 1983, pages 42-43.

"Installing New Non-Corrosive Anchors in Old Masonry: Some Examples," by Theodore H.M. Prudon, APT Bulletin, Vol. XI, No. 3, 1979, pages 61-76.

Engineering Geology Case Histories Number 11: Decay and Preservation of Stone edited by Erhard M. Winkler, Boulder, Colorado: 1977.

"An Architectural Example of Oxide Jacking," by M. Firth and W.M. Williams, APT Bulletin, Vol. XIII, No. 1, 1981, pages 3-6.

"Composite Stone Repairs at Drayton Hall," by Dean Koysan, APT Bulletin, Vol. XIV, No. 3, 1982, pages 36-41.

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"Rehabilitation Approaches to Severely Deteriorated Brown Sandstones at the Apex Building, Washington, D.C.," by Neale Quenzel, APT Bulletin, Vol. XVII, No. 3/4, 1985, pages 65-68.

"The Decay of Building Stones: A Literature Review," by Erhard M. Winkler, APT Bulletin, Vol. IX, No. 4, 1977, pages 52-61.

Conservation of Stone published by International Institute for Conservation of Historic and Artistic Works (IIC), second edition, London, Vol. 1, 1971.

"Field Procedures for Examining Humidity in Masonry Buildings," by W. Brown Morton III, APT Bulletin, Vol. VIII, No. 2, 1976, pages 2-19.

"Letter re Field Procedures.. by W. Brown Morton, III, and Later Comment by Louis J. Dugas," by Erhard M. Winkler, APT Bulletin, Vol. X, No. 1, 1978, pages 3-5.

Book Review by David W. Look of "Desalination of Stone: A Case Study," by M.J. Bowley, APT Bulletin, Vol. VIII, No. 2, 1976, pages 78-79.

"A New Air Pollution Monitor," by Paul Stumes, APT Bulletin, Vol. IX, No. 1, 1977, pages 16-21.

"A Masonry Deterioration Case Study: Holy Trinity Anglican Church, Hawkesbury, Ontario," by Martin E. Weaver, APT Bulletin, Vol. X, No. 1, 1978, pages 10-19.

"Stone Preservation, the Earth Scientist's View," by Erhard M. Winkler, APT Bulletin, Vol. X, No. 2, 1978, pages 118-121.

"Historic Concrete Preservation Problems at Fort Washington, Maryland," by Gary Scott, APT Bulletin, Vol. X, No. 2, 1978, pages 121-132.

"Injection D'Epoxy Sous Pression," by Francois Leblanc, APT Bulletin, Vol. X, No. 3, 1978, pages 41-58.

"History, Deterioration, and Repair of Cement and Concrete in Nineteenth Century Fortifications Constructed by the Royal Engineers," by Andrew Powter, APT Bulletin, Vol. X, No. 3, 1978, pages 59-77.

"The Lightness (Reflectance) of Stone in the Stone Industry," by Erhard M. Winkler, APT Bulletin, Vol. XI, No. 2, 1979, pages 7-16.

"Nondestructive Evaluation in Rehabilitation and Preservation of Concrete and Masonry Materials," by James R. Clifton, Rehabilitation, Renovation, and Preservation of Concrete and Masonry Structures edited by Gajanan Sabnis, American Concrete Institute SP-85, Detroit: 1985.

"Nondestructive Testing for Heritage Structures," by Susan Hum-Hartley, APT Bulletin, Vol. X, No. 3, 1978, pages 4-20.

Nondestructive Testing Handbook edited by Robert C. McMaster, New York, 1973(?)

"Scaled-Rectified Photography on Site," by William B. Hockey, APT Bulletin, Vol. VII, No. 3, 1975, pages 37-78.

"The Use of a Technical Model as a Design Control Aid," by Richard Fairweather, APT Bulletin, Vol. IX, No. 1, 1977, pages 22-29.

"Masonry Conservation: Documenting the Condition and Treatment of Historic Building Materials," by Anne E. Grimmer, Technology and Conservation, Vol. 6, No. 2, Summer 1981, pages 32-35.

"Weathering of the Kansas Capitol Building: A Study of Limestone Deterioration," by David A. Grisafe, Technology and Conservation, Vol. 7, No. 1, Spring, 1982, pages 26-31.

"Decay of Stone Monuments and Buildings: The Role of Acid Rain," by Erhard M. Winkler, Technology and Conservation, Vol. 7, No. 1, Spring 1982, pages 32-36.

"Radiography of Ancient Structures on the Acropolis of Athens: Mapping/Evaluating the Metal Joints and Reinforcement of Marble Monuments," by Eric T. Clarke, Technology and Conservation, Vol. 8, No. 3, Fall 1983, pages 18-22.

"Substitute Materials on the Western Reserve Historical Society Building," by Siegfried Buerling, APT Bulletin, Vol. XIV, No. 3, 1982, pages 7-11.

"A Stone Porch Replicated in Wooden Blocks," by Morgan Phillips, APT Bulletin, Vol. XIV, No. 3, 1982, pages 12-20.

"Glass-Reinforced Plastic Facsimiles in Building Restoration," by John A. Fidler, APT Bulletin, Vol. XIV, No. 3, 1982, pages 21-25.

"Composite Stone Repairs at Drayton Hall, A Case Study of Stone Restoration Techniques," by Dean Korpan, APT Bulletin, Vol. XIV, No. 3, 1982, pages 36-41.

Stone Consolidating Materials -- A Status Report by James R. Clifton, National Bureau of Standards Technical Note 1118, Washington, D.C.: May 1980.

A Glossary of Historic Masonry Deterioration Problems and Preservation Treatments compiled by Anne E. Grimmer, Washington, D.C.: 1984.

Moisture Problems in Historic Masonry Walls, Diagnosis and Treatment by Baird M. Smith, Washington, D.C.: 1984.

Analysis and Treatments--Mortar (and Stucco)

Knowledge about how to collect and document mortar samples so that it can be analyzed to be used as a clue to the evolution of a building, for example, as evidence of new additions or maintenance practices; and to provide information about the constituents (cement, sand, fiber, etc.); information about the compressive and shear strength of the mortar; and information about the visual qualities of the mortar (sand color, etc.)

Basic Level

--Knowledge about the visual properties of mortars and how to find and take samples of historic unweathered morter to be used for analysis.
--Knowledge about the methodologies of mortar analysis.
--Awareness of the effects of weathering.
--Knowledge about the performance of old and new mortars in historic masonry walls and various aspects of the properties of mortar including strength, porosity, plasticity, shrinkage, mortar proportions.
--Knowledge of how lime was produced historically (including burning of limestone and hydration of lime).

Advanced Level

--Knowledge about the analysis of mortar to assist in formulating new mortars.
--Ability to perform analyses to estimate relative proportions of the major groups of materials found in mortars including chemical tests and instrumental analytical methods.
--Knowledge about the effects of weathering on changes of texture, sands and pigments.
--Knowledge about stabilities of mortar and various efflorescences, hygroscopic salts and clays.
--Knowledge about the chemistry of mortars.

Master Level

--Awareness of current researches (testing and analysis) being performed internationally and throughout the United States on mortar and stucco as materials.
--Ability to understand and interpret the mortar analysis.

Selected Bibliography:

"SPNEA-APT Conference on Mortar, Boston, Massachusetts, March 15-16, 1973," by Morgan W. Phillips, APT Bulletin, Vol. VI, No. 1, 1974, page 9-39.

"Brief Notes on the Subjects of Analyzing Paints and Mortars and the Recording of Moulding Profiles," by Morgan W. Phillips, APT Bulletin, Vol. X, No. 2, 1978, page 77-89.

"Chemical Techniques of Historic Mortar Analysis," by John Stewart and James Moore, APT Bulletin, Vol. X, No. IV, 1982, page 11-16.

"Tests for the Analysis of Mortar Samples," by E. Blaine Cliver, APT Bulletin, Vol. VI, No. 1, 1974, pages 68-73.

Analysis and Treatments--Cleaning

Knowledge about techniques for cleaning historic structures to be able to understand the need and methods for testing and the effect of weather and temperature in determining the best cleaning method; to be able to match the technique to the material and condition; to be able to understand the chemical interaction between building materials and the cleaning agents and the effect those agents can have on those portions of the historic structure not intended for cleaning, for example, cleaning the cast iron facade by sandblasting while protecting the wooden window sash.

Basic Level

--Understanding Secretary's Standards and their application to NPS properties.
--General knowledge of historic materials and conservation techniques.
--Familiarity with Pres. Briefs 1, and NPS Masonry Glossary.
--Understanding "gentlest means possible" and understanding the methodologies for developing the "gentlest means possible" for an historic structure.
--Understanding the principles for cleaning metals including paint and products of corrosions.

Advanced Level

--Ability to direct and/or specify work for specific cleaning tasks like removing lipstick on marble, limestone cleaning, poultices for stain removal, etc.
--Knowledge about cleaning bronze statuary, especially problems associated with removing patina by chemical, abrasive or glass bead application.

Master Level

--Command of various cleaning techniques and full understanding of the ranges of stains and dirt, and knowledge about state-of-the-art (e.g. use of liquid nitrogen to remove bituminous coatings and paint).
--Knowledge about the use of paints as an alternative to cleaning difficult or damaged surfaces including masonry or metals.

Continuing Education: (Check with these organizations for current and future course availability)

--NPS training for Maintenance Managers, Maintenance Technicians, and Historical Architects
--Campbell Center
--Association for Preservation Technology (APT)
--University of York, Great Britain

Selected Bibliography:

"Preservation Briefs 1: The Cleaning and Waterproof Coating of Masonry Buildings" by Robert C. Mack, Washington, D.C.: 1975.

"Preservation Briefs 6: Dangers of Abrasive Cleaning to Historic Buildings," by Anne E. Grimmer, Washington, D.C.: 1979.

"Preservation Briefs 10: Exterior Paint Problems on Historic Woodwork," by Kay D. Weeks and David W. Look, Washington, D.C.: 1982.

Introduction to Early American Masonry ... by Harley J. McKee, Washingto, D.C.: 1973.

"The Chemistry of Masonry Cleaning," by Harold L. Heller, APT Bulletin, Vol. IX, No. 2, 1977, pages 2-9.

"Notes on the Treatment of Oil and Grease Staining on a Masonry Surface," by Frank G. Matero and Jo Ellen Freese, APT Bulletin, Vol. X, No. 2, 1978, pages 132-141.

"Several Experiences Using Lime Paste as a Cleaning Agent for Oil Paint," by Morgan W. Phillips and Brian Powell, APT Bulletin, Vol. XIV, No. 2, 1982, pages 30-33.

"A Diagnostic Study and Treatment Evaluation for the Cleaning of Perry's Victory and International Peace Memorial," by Frank G. Matero, APT Bulletin, Vol. XVI, No. 3/4, 1984, pages 39-51.

Conservation of Historic Buildings, by Bernard M. Feilden, London: 1982.

Exterior Cleaning of Historic Masonry Buildings by Norman R. Weiss, Washington, D.C.: 1977.

Metals in America's Historic Buildings by Margot Gayle and David W. Look, Washington, D.C.: 1980.

Analysis and Treatments--Repointing

Knowledge about repointing of historic masonry structures to understand the design and impact of the craft practices and the chemical and color composition of the mortar; to be able to identify and prescribe needed repointing; to be able to prescribe the careful removal of mortar if needed; to understand the purpose of mortar as a sacrificial unit to the masonry; and to understand the overall functioning of mortar in allowing for the dynamics of the structure with the attendant dangers from sealants and overstrength mortar formulas.

Basic Level

--Understanding present masonry construction, craft practices (pencilling), bonding patterns, mortar materials, and familiarity with basic literature, such as Preservation Briefs 2 and similar source materials.
--Ability to recommend when pointing is to be done and to what extent it is needed.
--Knowledge and ability to specify and supervise repointing to assure the character and the performance of the masonry is preserved.
--Knowledge about methods to remove old mortar without damaging adjacent masonry.

Advanced Level

--Ability to prepare or direct the preparation of mortar analysis, and prepare samples for matching historic mortar colors, tooling, etc.
--Ability to deal with replication of unusual or regional historic repointing practices, such as historic tuck pointing.
--Knowledge about applications of using mechanical methods to remove mortar where that is appropriate.
--Knowledge about packing and repacking the joints.
--Awareness of the problems of badly deteriorated or missing header mortars.

Master Level

--Expert on mortar chemistry, historic craft practices, can participate in teaching demonstrations on the mixing and matching of mortars.
--Knowledge about the pros and cons of other methods such as masking and sealants.
Knowledge about how and when to use sealants, for example, on exterior steps.
--Ability to grout or repack the joints.
--Ability to evaluate the structural problems to determine whether repacking or use of a grouting system would be more appropriate.
--Knowledge of how to repair and repoint mud mortars with lime pointing.

Continuing Education:

--Repointing demonstration given at "Maintenance: Historic Structures for Technicians" by NPS in Harpers Ferry, WV

Selected Bibliography:

"Preservation Briefs 2: Repointing Mortar Joints in Historic Brick Buildings," by Robert C. Mack, de Teel Patterson Tiller, and James R. Askins, Washington, D.C.: 1980.

"Brick Bibliography" by John R. Volz, APT Bulletin, Vol. VII, No. 4, 1975, pages 38-49.

Introduction to Early American Masonry ... by Harley J. McKee, Washington, D.C.: 1973.

"The Russack System for Brick and Mortar Description: A Field Method for Assessing Masonry Hardness," by Maximilian L. Ferro, Technology and Conservation, Vol. 5, No. 2, Summer 1980, pages 32-35.

"An Introduction to Repointing," by Robert C. Mack and James S. Askins, APT Bulletin, Vol. XI, No. 3, 1979, pages 44-60.

The Repointing of Historic Masonry Buildings, by Robert C. Mack and James S. Askins, Downers Grove, Illinois: 1979.

Analysis and Treatments--Structural Movement

Understanding techniques for monitoring structural movement, cracks, deflection, the effects of vibration in historic structures; knowledge about the technology for monitoring crack movement using such devices as strain gauges, electronic gauges, engineering "tell tales". Understanding testing of historic materials, where appropriate, to determine their structural capacities in tension, compression, shear, etc. Understanding how to evaluate historic structural systems that are indeterminate. Understanding the structural qualities that are contributed by such membranes of historic buildings as flooring, lathing, and sheathing. Understanding the principles and practices of reinforcement of historic masonry and wooden systems to strengthen and supplement the original system where possible and to provide a new system that will minimize the loss of historic fabric and meet structural requirements. For example, knowledge about soil stabilization, grouting, and other techniques to deal with differential settlement and other foundation damage. Knowledge about underpinning practices and needling to develop new spread footings for better distribution of imposed live and dead loads. Ability to diagnose structural movement which could be a function of soil subsidence, excavations, changes of water table; skill in diagnosing weaknesses in the structural system or connecting joints that are contributing to distortion, subsidence, deflection, etc..

Basic Level

--Ability to read cracks for basic structural forces, including vibration.
--Knowledge about stability of the "middle third" and understanding the engineering principles behind it.
--Basic techniques for measuring structural movement.
--Understanding generally accepted practice for reinforcement or improving the structural system, for example, introducing new supporting members.
--Knowledge about the basic problems of making the structural system too strong or too stiff.
--Understanding the basic systems of reanchoring masonry or decorative elements, as in facades, ornaments, and cornices.
--Basic understanding of seismic reinforcing systems.
--Ability to select and use a structural engineer familiar with working on and evaluating historic structures.
--Understanding of basic damage control and stabilization evaluation techniques.
--Knowledge about shoring, underpinning and scaffolding systems.
--Knowledge about the effects of vibration caused by traffic, blasting, construction, and other external sources.

Advanced Level

--Knowledge of how to monitor and evaluate the soil behavior, i.e. shrinkage and subsidence.
--Ability to interpret the measurements of structural movement.
--Ability to specify and supervise methods to correct structural movement in design of the simpler reinforcement systems.
--Ability to develop methods beyond generally accepted practice to reinforce or improve the structural system.
--Understanding the more complex systems for reanchoring masonry or decorative elements.
--Ability to make definitive evaluations regarding structural stability following a fire or natural catastrophe such as flood or earthquake, recognizing that the first 24 hours are critical to the structure's future survival.
--Ability to design simpler shoring, underpinning and scaffolding systems.
--Knowledge about how to monitor the effects of vibration over time and how to design a system for such monitoring.

Master Level

--Ability to design more complex reinforcement systems.
--Ability to design shoring, underpinning and scaffolding system for all structures.
--Knowledge about unusual techniques for soil stabilization, such as chemical freezing and soil modification such as grouting and mud jacking.
--Knowledge of when and how to remove or open up a ceiling, floor or wall, to ascertain if repairs are needed. Since such practices often lead to the destruction of original fabric, ability to mitigate such actions so that portions of the fabric can be retained in place or to be able to assess the structural condition sufficiently that such destruction is not needed at all.
--Knowledge about ways to mitigate the effects of vibration.

Selected Bibliography:

"Observed and Computed Settlements of Structures in Chicago," by Ralph B. Peck and Mehmet Ensar Uyanik, University of Illinois Bulletin Engineering Experiment Station, No. 429, Vol. 52, No. 53, March 1955.

"Effect of Vibration on Historic Buildings: An Overview," by J.H. Rainer, APT Bulletin, Vol. XIV, No. 1, 1982, page 2-10.

"Building Conservation: Bibliographical Notes" by Charles St. George Pope, APT Bulletin, Vol. V, No. 1, 1973, pages 65-67.

"Assessing the Effect of Vibration on Historic Buildings," by Walter Sedovic, APT Bulletin, Vol. XVI, No. 3/4, 1984, pages 52-61.

"Damp Buildings, Old and New," by Givanni and Ippolito Massari, APT Bulletin, Vol. XVII, No. 1, 1985, pages 2-30.

Conservation of Historic Buildings, by Bernard M. Feilden, London: 1982.

"Computer Enhancement of Radiographic Films Used in Structural Investigation of an Historic Structure," by William Firschein, APT Bulletin, Vol. XIV, No. 2, 1982, page 19.

"A Simple Method for Measuring the Yield Strength of Steel in Heritage Buildings," by Don Nixon, APT Bulletin, Vol. XV, No. 2, 1983, pages 17-19.

"Nondestructive Techniques for Evaluating Metalic Artifacts of Historical Interest, by Paul Wencil Brown and James R. Clifton, APT Bulletin, Vol. VIII, No. 4, 1976, pages 2-21.

"Structural Reinforcement of Historic Wooden Temples in Japan," by Kiyoshi Kaneta, APT Bulletin, Vol. XII, No. 1, 1980, page 75.

"A Preservation Monitoring System at Tumacacori National Monument," by Anthony Crosby, APT Bulletin, Vol. X, No. 2, 1978, page 47.

Analysis and Treatments--Paint

Knowledge about how to remove and document paint samples and how to analyze paints and finishes and knowledge about how to use the analysis and take into account the changes that may have occurred to the paints or finishes over time; and how to use the analysis to aid in producing new paints or finishes that will be historically correct in all respects.

Basic Level

--Knowledge of standard color references like NBS-Munsell.
--Knowledge about historic catalogs like Devoe, Sherwin Williams.
--Knowledge about how to use paint in chromochronology and color matching.
--Knowledge of literature on historic painting practices, uses of color, decorative painting.
--Knowledge enough about painting practices to be able to distinguish prime coats, and undercoats (for marbling and graining) from finish coats.
--Knowing how to recognize dirt layers. Knowledge of paint film failures and general remedies.
--Understand color migration (fading and intensifying). Understand properties of paint constituents, especially vehicles, properties of fugitive pigments.
--Understand basic kinds of paints, such as calsomine, oil paints, latex. Be aware of graining and marbling.

Advanced Level

--Knowledge about specific performance of historic and modern paint ingredients i.e., pigments and vehicles.
--Knowledge about graining characteristics and to be able to specify glazed and rubbed finishes.
--Knowledge about dealing with failed paint film, preparing substrates for new paint films.
--Knowledge about paint chemistry to be able to specify modern paint systems and a variety of conditions.
--Knowledge about decorating, painting, stencilling, daubing, their tools, etc.
--Ability to perform paint analysis both chemical and physical. Knowledge about microscopy.

Master Level

--Knowledge about the more unusual finishes such as scagliola, decorative lacquers.
--Knowledge about specifying modern high-performance coatings (organic coatings, modern automatic finishes).
--Knowledge about re-attaching failed paint films.

Selected Bibliography:

"Techniques Employed at the North Atlantic Historic Preservation Center For the Sampling and Analysis of Historic Architectural Paints and Finishes," by Carole L. Perrault, APT Bulletin, Vol. X, No. 2, 1978, page 6-46.

"Historic Exterior Paints -- Guidelines for Establishing Whether a Sample Contains a Layer Original to the Building's Construction," by Nancy Locke Doonan, APT Bulletin, Vol. XIV, No. 2, 1982, page 26-29.

"Note Re: Paint," contributed by Harley McKee, APT Bulletin, Vol. II, No. 1/2, 1970, page 14.

Glass, Paints, Varnishes and Brushes by Pittsburgh Plate Glass Company, Pittsburgh, PA: 1923.

International Library of Technology, Vol. 32, on Plumbing and Gas-Fitting, Heating and Ventilation of Buildings, Painting and Decorating, Estimating and Calculationg Quantities, by International Textbook Company, includes material on marbling, graining, stenciling, gilding and paper hanging (138 pages), Scranton, PA: 1903.

"Discoloration of Old House Paints: Restoration of Paint Colors at the Harrison Gray Otis House, Boston," by Morgan W. Phillips, APT Bulletin, Vol. III, No. 4, 1971, pages 40-47.

The Tasteful Interlude: American Interiors Through the Camera's Eye 1860-1917, by William Seale, New York: 1975.

Century of Color: Exterior Decoration for American Buildings 1820-1920, by Roger W. Moss, Watkins Glen, New York: 1981.

Munsell Book of Color Glossy Finish Collection, 1976 edition, available from Munsell Color, 2441 N. Calvert St., Baltimore, Maryland 21218, 301-243-2171, cost $717.00.

"Some Personal Observations on the Use of Paint in Early Ontario," by Jeanne Minhinnick, APT Bulletin, Vol. VII, No. 2, 1975, pages 15-30.

"The Peter Wentz House 18th Century Sponge Painting in Pennsylvania," by Frank Sagendorph Welsh, APT Bulletin, Vol. VII, No. 2, 1975, pages 124-130.

"Restoration of the Exterior Sanded Paint at Monticello," by Frank S. Welsh and Charles L. Granquist, APT Bulletin, Vol. XV, No. 2, 1983, pages 2-10.

"Zinc for Paint and Architectural Use in the 19th Century," by Arthur Channing Downs, Jr., APT Bulletin, Vol. VIII, No. 4, 1976, pages 80-99.

"A Methodology for Exposing and Preserving Architectural Graining," by Frank S. Welsh, APT Bulletin, Vol. VIII, No. 2, 1976, pages 70-75.

"Acrylic Paints for Restoration," by Morgan W. Phillips, APT Bulletin, Vol. XV, No. 1, 1983, pages 2-11.

See chart entitled "History of Coating Industry in the United States," APT Bulletin, Vol. V, No. 1, 1973, pages 6-7.

"The Introduction of American Zinc Paints, ca. 1850," by Arthur Channing Downs, Jr., APT Bulletin, Vol. VI, No. 2, 1974, pages 36-37.

"Some Notes on Paint Research and Reproduction," by Morgan W. Phillips and Norman R. Weiss, APT Bulletin, Vol. VII, No. 4, 1975, pages 14-19.

"A Mid-Nineteenth Century Color Scheme," by Calder Loth, APT Bulletin, Vol. IX, No. 2, 1977, pages 82-88.

"Paints for Architectural Cast Iron," by Pamela W. Hawkes, APT Bulletin, Vol. XI, No. 1, 1979, pages 17-36.

"Some Architectural Conservation Health Hazards," by Richard Byrne, APT Bulletin, Vol. XI, No. 2, 1979, pages 23-29.

"A Rare Example of Early Nineteenth Century Trompe L'Oeil Decoration," by Frank G. Matero, APT Bulletin, Vol. XV, No. 3, 1983, pages 34-38.

"Conservation and Transfer of an Early 19th Century Painted Room," by Ian Hodkinson, APT Bulletin, Vol. XIV, No. 1, 1982, pages 17-35.

APT Bulletin, Vol. XVI, No. 1, 1984, entire issue is on "Decorative Finishes."

"A Study of Historic Paint Colors and the Effects of Environmental Exposures on Their Colors and Their Pigments," by Peggy A. Albee, APT Bulletin, Vol. XVI, No. 3/4, 1984, pages 3-25.

"Removal of Interior Coatings at the Statue of Liberty," by Frances Gale and John C. Robbins, APT Bulletin, Vol. XVI, No. 3/4, 1984, pages 63-65.

Paint Color Research and Restoration of Historic Paint compiled by Kevin H. Miller, Ottawa, Canada: 1977.

Aurora Blue: Identifying and Analyzing Interior Paint in an Oregon Utopia, ca. 1870 by Bonnie Wehle Parks, (Cultural-Technical Booklet Number Two), Eugene, Oregon: 1986.

Conservation of Historic Buildings, by Bernard M. Feilden, London: 1982.

Analysis and Treatments—Mechanical and Electrical Systems

Understanding the need to design a Heating/Ventilation/Air Conditioning (HVAC) system to meet the use and occupancy needs of the historic structure without causing extensive loss of historic fabric or creating an HVAC system that is visually inappropriate to the structure's historic character or one that will cause excessive vibration or noise as a result of introducing new equipment. Understanding how to take into account the existence of historic mechanical equipment and their possible reuse. Understanding how to use the configuration of the building in the design and distribution of mechanical equipment, be it heating, cooling, electrical, plumbing, whatever. One of the most difficult aspects of restoration work is understanding how to design an HVAC system that will meet the needs of both the historic structure and any objects that may be exhibited. Understanding the interrelationship between certain kinds of energy retrofitting such as insulating cavity walls with the installation of environmental control equipment that might have the effect of introducing condensation into the wall or increasing the moisture level of wooden members embedded in the masonry.

Basic Level

--Knowledge about how to recognize existing systems.-- Have a talking knowledge about retrofitting of existing systems, such as new controls, putting a pump on a gravity system, putting fans on a gravity air system, new boilers.
--Ability to recognize historic character of existing grilles and outlets, radiators.
--Knowledge about how to hide a system to minimize visual and physical impact.
--Understand the variety of ways to light historic spaces with historically appropriate and safe equipment.
--Understanding the factors for selection and insulation regarding insulation in cavity walls, and vapor retarders.
--Knowledge of noise attenuation systems, and ability to discuss them with mechanical engineers.

Advanced Level

--Ability to use state-of-the-art technology such as special lighting fixtures, small diameter plumbing and venting or flat cable wiring, especially for low voltage, under carpets, under wall paper.
--Knowledge of historic insulative systems such as seaweed, horsehair, sand, waffle and daub, biscuits, etc.
--Knowledge about special materials for preserving historic electrical fixtures including special wire.
--Understanding the interface between environmental control needs for collections and the structure -- understand the problems of achieving such balance where there is high visitation, where there is no vestibule.

Master Level

--Knowledge about special considerations for museum objects, or special considerations for unusual configurations of historic buildings.
--Knowledge about how to find a knowledgable engineer or contractor to test and evaluate historic heating systems.

Selected Bibliography:

"Heating Stoves in 18th Century Philadelphia," by Samuel Y. Edgerton, Jr., APT Bulletin, Vol. III, No. 2/3, 1971, pages 15-104.

"The Infancy of Central Heating in the United States: 1803 to 1845," by Benjamin L. Walbert III, APT Bulletin, Vol. III, No. 4, 1971, pages 76-88.

"A Signed and Dated 1851 Furnace in Rome, New York," by Orville W. Carroll, APT Bulletin, Vol. III, No. 4, 1971, pages 89-92.

"Chapter XXX, Heating and Ventilation of Buildings," and "Chapter XXXI, Chimneys," by Louis A. Harding, in the Kidder-Parker Architects and Builders Handbook, by Frank E. Kidder and Harry Parker, 18th edition, New York: 1945.

International Library of Technology, Vol. 32, on Plumbing and Gas-Fitting, Heating and Ventilation of Buildings, Painting and Decorating, Estimating and Calculating Quantities; the section on Heating and Ventilation of Buildings (196 pages); Scranton, PA: 1903.

Modern Engineering Practice: Vol. XII, Ventilating, Heating, Plumbing, Carpentry, Index edited by Frank W. Gunsaulus, Chicago: 1906. Includes chapters on Warming, Ventilation, Heating, Plumbing, Sewerage, Water, pages 11-316.

Building Early America, edited by Charles E. Peterson, Radnor, Pennsylvania: 1976.

Outline of History of Lighting by Gas by Dean Chandler, London, 1936.

Modern Plumbing Number Eight J.L. Mott Iron Works, New York: 1914. (First Edition.)

Collection of Heating and Lighting Utensils in the United States Natonal Museum by Walter Hough, Smithsonian Institution United States National Museum Bulletin 141, Washington, D.C.: 1928.

Industrial Chicago The Building Interests The Goodspeed Publishing Company, Chicago: 1891. with chapters on Plumbing, Heating and Ventilation, Gas and Electric Lighting, Paving, Wood, Painting.

"Building Automation System at Iolani Palace, Honolulu, Hawaii," by Randall J. Biallas, APT Bulletin, Vol. XIII, No. 1, 1981, pages 7-15.

"Steam and Hot-Water Fitting," by W.G. Snow (pages 135-200); "Electric Wiring" by Charles E. Knox (pages 201-272); "Electric Bell Wiring," by H.C. Trow (pages 273-284); "Electric Lighting," by G.C. Shaad (pages 285-350) in "Reinforced Concrete, Steam Fitting, Electricity," Vol. IV of Cyclopedia of Architecture, Carpentry and Building, American Technical Society, Chicago, 1908.

Heating and Ventilating of Buildings Vol. 241 of the International Library of Technology, International Correspondence Schools, Scranton, Pennsylvania: 1928.

Plumbing and Gas Fitting Vol. 240B of the International Library of Technology, by International Correspondence Schools, Scranton, Pennsylvania: 1927.

Conservation of Historic Buildings, by Bernard M. Feilden, London: 1982.

"Electric Lighting and Wiring in Historic American Buildings: Guidelines for Restoration and Rehablitation Projects," by Melissa L. Cook and Maximilian L. Ferro, Technology and Conservation, Vol. 8, No. 1, Spring 1983, pages 28-48.

Gaslighting in America: A Guide to Historic Preservation by Denys Peter Myers, Washington, D.C.: 1978.

Analysis and Treatments--Fire Protection

Understanding fire prevention and protection planning principles; understanding how to analyze the historic structure for fire risks. Knowledge of current building codes and knowledge of the National Fire Protection Association guidelines and technical information. Knowledge of the various kinds of equipment, products and services related to fire detection and fire suppression. Understanding the various factors for selecting the use of such equipment and systems when historic structures are also being used for the exhibit of museum objects.

Basic Level

--Knowledge about basic concepts in fire protection.

--Knowledge about fire code equivalencies for historic structures including application to simple building types.

--Ability to evaluate historic structures according to the NPS Fire Equivalency Program for Overnight Lodging Facilities, especially when a change in usage is proposed or planned.

--Basic knowledge of the hardware of fire sprinkler and suppression systems. Knowledge about the pros and cons of semi-concealed installation and surface mounted installation.

--Understanding the principles for alternative locations for hardware, for example, sidewall sprinklers as opposed to ceiling sprinklers.

--Knowledge about the pros and cons of the various fire suppression systems and applications and knowledge about the limitations of Halon.

--Knowledge of portable or temporary systems, such as detector heads or suppression systems set into rooms after a building is closed for the night, e.g. a Halon tank.

Advanced Level

--Knowledge about the special and unique problems brought about by location and fire risks, for example not enough water pressure available to be able to use a sprinkler system.

--Knowledge about unusual ways of installing or concealing fire suppression systems.

--Knowledge about the rehabilitation of historic fire suppression systems, for example, the Edison Laboratory had a sprinkler system that it was possible to reuse.

--Knowledge of fire detection and suppression as equivalancy for meeting life safety codes.

--Ability to design and specify fire detection and fire suppression.

Master Level

--Knowledge about unusual ways of installing or concealing fire suppression systems.

--Knowledge about special considerations for museum objects or special consideration of unusual configurations of historic buildings relative to fire suppression.

Selected Bibliography:

"Chapter XXII, Fire-Proofing of Buildings," by George E. Strehan in Kidder-Parker Architects and Builders Handbook by Frank E. Kidder and Harry Parker, 18th edition, New York: 1945.

"Safety Considerations in Halon 1301 vs. CO_2 Fire Systems," by Herb Martin, APT Bulletin, Vol. X, No. 2, 1978, page 143.

"Fire Ratings of Archaic Materials and Assemblies," by Howard Markham, APT Bulletin, Vol. XIII, No. 2, 1981, pages 19-22.

Conservation of Historic Buildings, by Bernard M. Feilden, London: 1982.

"Fire Protection Planning for Cultural Institutions: Blending Risk Management, Loss Prevention, and Physical Safeguards," by Alphonse T. Tiszkus and E.G. Dressler, Technology and Conservation, Vol. 5, No. 2, Summer 1980, pages 18-23.

Analysis and Treatments--Maintenance Systems

Knowledge about the impact of maintenance practices on the historic structure; knowledge of cyclical maintenance needs; knowledge of those routine maintenance practices that can seriously harm the historic structure; knowledge of how to train maintenance personnel in appropriate maintenance techniques for historic structures; knowledge of how to prepare written maintenance guidelines. Knowledge of maintenance practices in the National Park Service.

Basic Level

--Understanding the component parts of an Historic Structure Preservation Guide. Ability to prepare such a Guide for a simple structure.
--Understanding of the basic elements and performance standards for inspection of existing conditions.

Advanced Level

--Ability to prepare Historic Structure Preservation Guides for more complex structures, or more complex building materials with a higher degree of finishes, or for structures with special preservation problems such as a severe environmental condition that will need special followup after consolidation.
--Understands the negative impact on certain maintenance practices, not only upon the materials but upon the system.
--Knowledge of how to set up a monitoring system to enable an architect to receive and evaluate necessary data.
--Recognition of the special problems for an historic structure created by how it is used.
--Ability to provide professional review of a Maintenance Management System.

Master Level

--Can analyze maintenance needs, and develop a management system to set up a long range program for preservation of historic properties.
--Ability to prepare Historic Structure Preservation Guide with a higher level of determination at what time do you suggest intervention as a result of maintenance.
--Ability to determine higher intensity of maintenance treatment or some specific preservation treatments.

Continuing Education:

--"Historic Preservation Maintenance" at Campbell Center
--"Maintenance: Cultural Resources for Managers" for NPS facility managers and superintendents
--"Maintenance: Historic Structures for Technicians" for NPS maintenance personnel

Selected Bibliography:

Cyclical Maintenance for Historic Buildings by J. Henry Chambers, Washington, D.C.: 1976.

Maintenance of Old Buildings: Preservation from the Technical and Antiquarian Standpoint by Ingmar Holstrom and Christina Sandstrom, Stockholm: 1975.

"Conserving Large Estates: Problems of Maintaining the Great Turn-of-the-Century Homes," by Maximilian L. Ferro, Technology and Conservation, Vol. 6, No. 3, Fall 1981, pages 22-27.

The Care of Old Buildings Today: A Practical Guide by Donald W. Insall, London, 1972.

Conservation of Historic Buildings, by Bernard M. Feilden, London: 1982.

Vieux Carre Masonry Maintenance Guidelines, New Orleans, LA: 1980.

Building Maintenance and Preservation edited by Edward D. Mills, London and Boston, 1980.

* Repair and Maintenance of Houses by Melville & Gordon

* "Handbook of Maintenance Techniques for Buildings...Texas," Rev.ed.1984, Texas Historical Commission

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*Note: Asterisked items signify incomplete citations.

PARTICIPATION IN THE SKILLS DEVELOPMENT PLAN

WHY YOU SHOULD ENROLL IN THE PLAN

There are a variety of personal and professional reasons why you might choose to participate in the Skills Development Plan including:

--increased opportunities for learning,
--increased recognition when sharing information, and
--gaining the ability to do more within an existing job.

WHAT YOU AGREE TO DO

When you enroll, you agree to prepare at least three "projects" during a three-year enrollment period. A "project" could be presented orally, in writing or graphicly.

The three "projects" are intended to help you improve your historic preservation skills and expertise. Examples of such "projects" are provided (on pages 5-6 of this section) to help you develop your interests so they can be of use to both you and the Service.

HOW YOU ENROLL

You enroll by filling out the enrollment form, asking your supervisor to concur in your enrollment, and following the instructions and timetable for participation. The enrollment form is an employee-supervisor agreement that acknowledges your commitment.

THE ROLE OF YOUR SUPERVISOR

Your supervisor's role in this Plan is to review and consider approval of your request for enrollment in the Skills Development Plan; to review your personal study plan annually; to assist in improving your skills within the framework of your current job; and to consider the allowance of a certain latitude within your job to permit the acquisition of new skills.

PARTICIPATION IN THE SKILLS DEVELOPMENT PLAN

There are two primary goals for participation in the Skills Development Plan. The first goal is to foster professional growth in the field of historic preservation to assure high quality preservation of cultural resources in the National Park Service; the second goal is to augment the base of shared knowledge for historic architecture and historical architects in the National Park Service. There are four steps that both address these goals and serve as requirements for your participation.

STEP 1. DEVELOP AN INDIVIDUAL DEVELOPMENT PLAN (IDP)*

The Individual Development Plan (IDP) is a document used for identifying your objectives for planning your career through training and special assignments. The IDP is an existing formal process and is required of all NPS personnel whether they're in this program or not. It becomes the administrative basis for planning training throughout the Service. The IDP can be used not only for formalized training but also for selected experiential opportunities including self-training, informal training, and on-the-job training. Self-training can include reading articles or learning how to use specialized preservation equipment. Informal training could include a visit to an Architectural Study Collection such as the one at Independence National Historical Park or a visit to a factory that produces components for historic building systems. On-the-job training could include accompanying a senior level historical architect on an inspection of structures to record with sketches and photographs the problems and range of solutions considered. We encourage you to fully utilize the potential of this form. The IDP becomes the official basis for the next step, which will require that you expand your career planning to encompass the steps required for participation in the Skills Development Plan.

STEP 2. DEVELOP A PERSONAL STUDY PLAN

You need to develop an annual Personal Study Plan for skills development. This study plan should define an area of job-related professional interest; estimate the amount of job time and identify the kinds of tasks needed to develop this interest; and describe the resulting product. (See Sample Study Plan on next page). This Personal Study Plan should be reviewed by your supervisor, then sent to the Skills Development Plan Coordinator for review by the authors and to provide guidance on bibliographic or other sources and about accomplishing the final product. Note that it is important to narrow the scope of your topic; especially in this first year of participation, think of a realistically achievable, job-related task and "project." If your colleagues have similar areas of interest, please coordinate the development of your personal study plan with theirs.

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*Note: The acronym, IDP is coincidentally used by both the National Park Service and the National Council of Architectural Registration Boards but this acronym describes TWO DIFFERENT programs. The National Park Service IDP means Individual Development Plan and is a single page form that is prepared annually to accompany Employee Performance Standards; its use is described here. The National Council of Architectural Registration Boards' IDP means Intern-Architect Development Program and is described in detail in the "Appendix A: NPS Intern-Architects Guide to Architectural Licensing."

SAMPLE PERSONAL STUDY PLAN

Area of Interest

I select local slate roofing practices as my area of interest, this will enable me to increase my knowledge of historic roofing practices *per se*, to better evaluate the condition of existing roofs, to give advice on roofing repairs, and to write specifications. Study of slate roofing practices includes the kinds and colors of slate used, the shapes, geometric patterns, the use of polychrome slating and the use of slates that are graduated in size, how these roofing practices handled problems of valleys, ridges, dormers, turrets, vent stacks, and eaves; I am also interested in the various repair and replacement techniques and tools.

Estimated Time Needed to Develop This "Project"

--I estimate that it will take 3 weekends to visually survey, photograph, identify buildings and take notes in this study area.
--2 days of office time to review and obtain copies of historic photographs in the local historical society records.
--2 days of office time to study, organize and annotate those historic photographs.
--Some personal time needed to collect, where possible, samples of slates from demolished buildings that can be used for reference purposes in explaining and demonstrating slating materials and characteristics with some evidence of craft practices and for the purposes of writing specifications.
--Some personal time to look at: earlier trade catalogs if available, general articles regarding the history of roofing, and to consult articles in the Selected Bibliography.
--1 day for consultation and comments from supervisor and other colleagues as to the direction of this Study Plan and the achievability of the written and graphic "project."
--1 day of office time for oral interviews with local roofing contractors about slate repair techniques to discuss methods to avoid damaging adjacent slates during repair, including taking photographs of their tools and equipment.

Final "Project"

A mixture of 1 day personal time and 1 day office time to prepare the final written and graphic project which may include new photographs, slides, annotated historic photographs, sketches, drawings, summary of interviews, written report or poster board. Copies to be made for the office and regional files, copies to the local historical society and a copy to the Skills Development Plan Coordinator.

STEP 3. DEVELOP PERSONAL "PROJECTS"

You need to prepare three presentations during your three year enrollment. These presentations are your personal skills development "projects." They are intended to demonstrate your personal/professional development and should take place in an arena where there are reader or audience responses. These "projects" can be in an oral, written and/or graphic format or any combination. When completed, copies of the "project" are to be made for your office, your region, the local cooperating organization (such as an historical society) and the Skills Development Plan Coordinator.

Examples of Oral "Projects"

You could:

use an onsite visit to an historic district, building, or preservation project to focus on one of your areas of interest, to observe, take photographs and prepare a "brown bag" lunch slide/lecture on your topic of study;

collaborate with NPS or other colleagues to do an informal workshop on a specific topic;

prepare a slide show or other "project" to a technical preservation audience, such as an architect's workshop, NPS training course, or the local APT chapter or Friends of Terra Cotta, on your research and findings;

assist the State Historic Preservation Office in their annual preservation workshop for local citizens, private architects and local design review boards;

Examples of Written "Projects"

You could:

develop or collaborate on an article for the CRM Bulletin, the APT Bulletin, a Preservation Tech Note;

prepare an annotated (and illustrated) compilation of buildings in your region that exhibit certain kinds of craft practices or preservation problems, for instance a list of examples of Luxfer prism glass in a district or city, a list of buildings with examples of patterned slate work, a list of places in an historic district where there is evidence of early paving and landscape materials;

familiarize yourself with stone types used in your geographical region by period of time to observe, record, or compile notes about the stone's visual and physical appearance, the evidences of regional craftsmanship as applied to that stone, and evidences of its performance in the environment; you could consult with geologists at the local university about its physical properties and availability and/or suitability for replacement or repair work;

Examples of Graphic "Projects"

You could:

develop a collaborative project with other colleagues, and prepare a compilation or compendium of historic photographs of historic structures in a given city or region and extensively annotate the photographs to point out building practices for different types of buildings and different periods of time. Such practices could include sash configuration, use of shutters, rain water disposal, roofing practices, paving patterns, painted brick work etc. This compendium could result in a very specific and sharable local report focusing on building technology and craft practices;

make a video on a craft technique or other topic;

participate in the preparation of an exhibit on historic architecture, building technology or craft technique for your office or at the local AIA chapter house or some other location;

prepare a "poster session" on a technical preservation topic;

select a masonry building or a small group of masonry buildings to use as a basis for a year-long study to observe the effects of moisture upon various types of masonry materials (brick, stone, stucco), to observe the effects of the building design or configuration upon its wetting, to observe the effects of building orientation, to observe the effects of roof overhangs, sidewalks, paving materials, and plant materials upon wetting and splash of masonry materials, to observe rising damp and "tide" marks upon walls, to regularly observe these buildings after every rain fall or snow fall where practical, to take photographs of the effects of wetting, to look for seasonal differences in wetting patterns and record the length of time required to dry out, to compile a chronological and visual record, to draw conclusions, where possible, and to present this information in a way that can be shared with others so that there is a permanent record of this period of observation.

STEP 4. PREPARE AN ANNUAL PERSONAL ASSESSMENT

You need to provide information on an annual basis on work undertaken and completed towards skills enhancement. (See page 10 for Annual Personal Assessment form.) This is a key ingredient to completing the program and receiving the certificate at the end of the first three year enrollment period. Your comments on improving the Skills Development Plan are also most important.

TIMETABLE FOR SUBMISSION OF MATERIAL TO BEGIN YOUR PARTICIPATION IN THE SKILLS DEVELOPMENT PLAN

By August 22, 1986, you send in:

--a copy of your Individual Development Plan,
--the Enrollment Form signed by you and your supervisor, and
--the Personal Study Plan developed by you and reviewed by your supervisor.

By September 30, 1986, you should receive:

--your Enrollment Form, fully signed,
--your Personal Study Plan with notes and comments, and
--a copy of sample text for preparing your next Individual Development Plan.

ENROLLMENT IN THE SKILLS DEVELOPMENT PLAN
FOR NPS HISTORICAL ARCHITECTS

Note: Make a photocopy of this form. When you and your supervisor have signed the photocopied form, mail it to: Skills Development Plan Coordinator, c/o Preservation Assistance Division (424), National Park Service, P.O. Box 37127, Washington, D.C. 20013-7217. When signed, it will be returned to you.

I want to enroll in the Skills Development Plan for National Park Service Historical Architects for a three year period. I agree to:

--prepare an annual Individual Development Plan;
--develop an annual Personal Study Plan for skills development;
--prepare three "projects" (oral, written, or graphic), during this three year period; and,
--provide information on an annual basis on work undertaken and completed towards skills enhancement in the Annual Personal Assessment.

_____ _____
NPS Historical Architect date

I concur:

_____ _____
Supervisor date
NPS Unit _____

Enrollment accepted on _____ and to be monitored annually by:

_____ _____
Chief Historical Architect date
National Park Service

_____ _____
Chief, Preservation Assistance Division date
National Park Service

_____ _____
Skills Development Plan Coordinator date
National Park Service

_____ _____
Chief Training Officer date
National Park Service

ANNUAL PERSONAL STUDY PLAN

Note: Make a photocopy of this form. After you have filled it out, ask your supervisor to review and surname it and mail it to: Skills Development Plan Coordinator, c/o Preservation Assistance Division (424), National Park Service, P.O. Box 37127, Washington, D.C. 20013-7127. It will be reviewed and returned to you with comments.

Name:

Office: Date:

Area of Job-Related Professional Interest for the year_____.

Estimated Time Needed To Develop This "Project" for the year_____.

Describe the Proposed "Project" for the year_____.

ANNUAL PERSONAL ASSESSMENT BY
NATIONAL PARK SERVICE HISTORICAL ARCHITECTS
PARTICIPATING IN THE SKILLS DEVELOPMENT PLAN

Name: Office:

Date:

Note: Make a photocopy of this Annual Personal Assessment form (pages 10-14), provide your comments, suggestions, and copies of material produced and mail as instructed on page 14. (Supervisors of historical architects are invited to make a photocopy and provide comments from their perspective, and send it in.)

We appreciate your cooperation in providing information on your participation in the Skills Development Plan. This information will not be used as a basis for evaluation by Personnel; it will be used to verify participation in this Skills Development Plan for National Park Service Historical Architects and to develop improvements to the Skills Development Plan and its implementation.

EVIDENCE OF YOUR PARTICIPATION

1. Please attach a copy of the Individual Development Plan (IDP).

2. Please provide a concise list of those training, projects, and office experiences that you had in the last year that you felt contributed to your attainment of one or more skills listed in the "Catalog." Use the back of the page or attach pages if needed.

3. Please provide a list of your "projects," talks, participation in symposiums, publications, Tech Notes, FEEDBACK, etc. and a copy of any materials developed.

4. Please provide any additional material you may feel is relevant to serve as evidence of your having attained elements of a given skill.

5. Any comments?

SUGGESTIONS FOR IMPROVEMENT OF THE SKILLS DEVELOPMENT PLAN

1. Please provide your suggestions on new training or improved existing training. Please provide your suggestions on awards or recognition systems that could be used in this Skills Development Plan.

2. Are there other areas of expertise that should be included in the basic or "must know" list of skills? If possible, please fill in all or part of a Selected Skill and send in with this assessment.

3. Can you suggest portions of Historic Structure Reports or Historic Structure Preservation Guides that contain information about a research technique or a craft technique that would have relevance to other projects, and should be shared with others?

4. Are there specific skills listed in the "Catalog" that you feel need to be developed into a training course?

5. Are there changes, additions, or deletions you would make to the Selected Biblographies?

6. Are you aware of training in your geographic area on a specific skill topic? Please provide the course name and a name, address, and telephone number.

7. Any comments?

SEND TO:

Please mail this information to:

Skills Development Plan Coordinator
c/o Preservation Assistance Division(424)
National Park Service
P.O. Box 37127
Washington, D.C. 20013-7127

Appendix A:

NPS Intern-Architects Guide to Architectural Licensing

May 1986

To assist NPS intern-architects in becoming licensed, the National Park Service, in consultation with the National Council of Architectural Registration Boards (NCARB), has adapted the NCARB synopsis of training detailed in the Intern-Architect Development Program to relate to work performed by the National Park Service. When finalized, this Guide will be part of a Memorandum of Understanding between NCARB and NPS.

There is some confusion in the use of term "architect" by those in the Federal government and the NCARB, its member boards and the American Institute of Architects. "Architect" when used by the Federal government is a job title, not a legally professional status, and it should not be assumed that persons so designated are licensed by individual states to practice the profession of architecture. When used by the U.S. architectural profession at large and its regulating bodies, "Registered Architect," "licensed architect," and "architect" have the same meaning. The "Historical Architect," at best, is first an architect ("registered architect"), with a specialty in historical buildings and should not imply that it is a profession unto itself with its own licensing bodies. The National Park Service encourages registration and has developed this document to assist staff in reaching that goal. The "Intern-Architect," a term used throughout this document, typically is one who holds a degree in architecture and is in the process of meeting a jurisdiction's experience requirement for registration.

Appendix A is a major section in its own right but addresses the short term goal of architectural licensing. (Note: participating in and enrolling in the **Skills Development Plan** is entirely separate from obtaining the necessary work experience to take the architectural examination.)

The decision to become registered is currently a personal choice. There are, however, instances in the Service in which registration is a requirement of the position. The work on Appendix A was undertaken to encourage registration as there are benefits to both you and the Service. If you are planning to become a supervisor in the future, your being registered will help those who work for you attain registration. Even if you do not become a supervisor, you will still be able to serve as an advisor for other intern-architects. Registration also improves your credibility with other agencies, with private firms, and within the Service.

If you are interested in becoming registered and are not working for a registered architect and need required supervision to meet NCARB requirements, please contact Emogene Bevitt or Hugh Miller,AIA. Fortunately many NPS architects are registered and instances such as this are believed to be few. On a case-by-case basis we will endeavor to work with you and your supervisor to find ways of meeting the requirements.

The authors are grateful to the National Council of Architectural Registration Boards, especially Samuel Balen, FAIA, Richard Van Os Keuls, AIA, and Robert Rosenfeld for their advice and assistance in completing this document. Special thanks go also to National Park Service staff including Randall Biallas, AIA, Anthony Knapp, and Kay Weeks.

NPS Intern-Architects Guide To Architectural Licensing

Introduction

What will you have to do to become a registered architect, that is, a person legally registered by a body which regulates the practice of architecture? This has been defined by each state in detail, but generally the requirements say a candidate must:

-receive a first professional degree in architecture from a program accredited by the National Architectural Accrediting Board (NAAB),
-work for 3 years in an architect's office gaining a wide range of experiences,
-submit a record describing this experience for evaluation and acceptance by a state registration board, and
-pass the architectural licensing examination.

As already noted, each jurisdiction has its own requirements for registration. For example, many states do not recognize Federal work experience in architecture as qualifying experience toward registration. Some jurisdictions have a formula that will allow a percentage of Federal work experience to count; others will consider Federal work experience on a case-by-case basis if the applicant presents convincing information.

There are two ways to approach registration: one is to work directly through a particular state registration board, comply with those standards, take the test when eligible, and pass it. The other is to initiate an applicant record with the National Council of Architectural Registration Boards (NCARB), have the completed record forwarded to the board, comply with the jurisdiction's standards, take the test when eligible, and pass it.

You are free to choose which process you would like to follow in attaining your goal. But because NCARB's education and training (experience) standards are recognized by all the jurisdictions and have been adopted by many, we decided to work with the NCARB standards in preparing this Guide.

Each registration board has the legal authority to establish requirements necessary for admission to examination and for registration. NCARB, as a federation of all registration boards of the United States, is charged with setting education, training, and examination standards for certification (the vehicle through which reciprocal registration may be obtained). The National Council of Architectural Registration Boards interprets, details and enforces their standards, maintains applicant records, and acts as the central clearinghouse and contact point for all intern-architects, registered architects, and registration boards in matters dealing with the registration and professional conduct of architects.

NCARB has literature including standards to assist the intern-architect at each step toward registration. NCARB has "Circulars of Information" on education standards, training standards and the architectural registration examination. Also available is a chart that illustrates the individual state requirements for registration.

One problem facing intern-architects who start working for the National Park Service right after graduation is finding that registration boards are reluctant to accept government work as qualifying architectural experience. This Guide seeks to address that problem by supplementing the information and guidance provided by NCARB; it illustrates the kinds of tasks an NPS intern-architect could perform to obtain qualifying architectural experience. The Guide is not meant to be used independent of NCARB or the registration boards, rather, it is intended to be used in conjunction with the NCARB Circulars of Information and other resource guides.

While the Office of Personnel Management does not generally require that individuals in Federal service become registered, the National Park Service (NPS) encourages registration. Registration has several benefits:

--registration fulfills a career goal;
--registration increases employment options beyond Federal service;
--registration enhances credibility with peers and within the profession; and,
--registration enhances the professional credibility of the Service when registered NPS architects can interact with private sector architects, contractors or with other professionals.

Working cooperatively, The American Institute of Architects and the NCARB have developed the Intern-Architect Development Program (IDP)*. Training requirements are based on the premise that interns should be well grounded in the diversified background of architectural practice prior to applying for a license. Based on surveys and studies, NCARB defined 14 job-related training areas, developed a method for charting progress in achieving exposure to these training areas, and identified IDP participants to monitor the intern's progress and to provide advice and assistance.

This Guide has been developed from the document IDP Training Guidelines and has been customized to conform with National Park Service practice. It has been customized to meet the specific needs of NPS staff. NCARB has expressed concern that individuals in Federal service may fail to acquire experience in one or more of these training areas and that this oversight may result in a skewed vision of the profession and practice of architecture. Thus, every care should be taken to achieve the balance NCARB recommends. (One of the primary requirements for participation in IDP is the completion of three years in a degree program accredited by the National Architectural Accreditation Board. Exceptions to this rule are few and require educational evaluation, testing, or additional extensive coursework. For more details please consult NCARB Circular of Information No. 3, Education Standard for Certification.) Please note: all fees incurred in participating in IDP and the fees needed to apply for licenses or renewal are the personal responsibility of the individual architect. The National Park Service is not allowed to pay for these expenses.

NPS intern-architects must be able to show how government work experience is directly related to that of an intern-architect in private practice. Work on historic structures must show a direct relationship to the comprehensive design process and not merely consist of repair and maintenance.

It is up to the individual to review the material provided by NCARB on the Intern-Architect Development Program to fully understand the program's objectives and requirements. It is up to the individual to work with their own supervisors and to develop their own plans for meeting these requirements based on work they may have performed in the private sector or on work performed for the Service. NPS intern-architects are encouraged to enroll in IDP by establishing an NCARB/IDP Council record. An IDP

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*Note: The acronym IDP is used by both the National Council of Architectural Registration Boards and the National Park Service but describes TWO DIFFERENT programs. With reference to NCARB, IDP means Intern-Architect Development Program and is described here. The National Park Service IDP means Individual Development Plan and is a single page form that is prepared annually to accompany Employee Performance Standards.

information package, including information to initiate an NCARB/IDP Council record, is available from the National Council of Architectural Registration Boards, Suite 700, 1735 New York Avenue NW., Washington, D.C. 20006.

I. Intern-Architect Development Program (IDP) Participants

The IDP participants consist of the intern-architect, a professional sponsor, and a professional advisor. The intern-architect is any individual in the process of satisfying a jurisdiction's examination eligibility requirements. The professional sponsor provides the daily supervision that is required by NCARB and helps to provide the intern-architect with the spectrum of experience and exposure that NCARB outlines. The professional advisor is a registered architect outside the intern-architect's immediate office with whom the intern meets to review progress and develop long range career goals. For further details see IDP Training Guidelines and IDP Sponsor/Advisor Guidelines.

II. The 14 Training Areas

To satisfy the IDP training standard, each architect is expected to gain 700 value units in the 14 training areas. (A value unit is 8 hours of acceptable experience.) The 14 training areas are:

1. Programming-Client Contact
2. Site and Environmental Analysis
3. Schematic Design
4. Building Cost Analysis
5. Code Research
6. Design Development
7. Construction Documents
8. Specifications and Materials Research
9. Documents Checking and Coordination
10. Bidding and Contract Negotiation
11. Construction Phase -- Office
12. Construction Phase -- Observation
13. Office Procedures
14. Professional Activities

For specific value unit requirements see the IDP Training Guidelines.

III. Documenting Internship Activities

A nationally recognized recordkeeping system has been developed by NCARB to assist the intern-architect in documenting and assessing internship activities. Although not mandatory for participation in IDP, the NCARB Council record is highly recommended. The Council record is a detailed, authenticated record of an intern's education, training and character. Upon establishing a Council record the intern will receive a set of NCARB/IDP report forms to record all training and supplementary education.

The Council recordholder's progress is carefully monitored at the NCARB office. When forwarded to NCARB, each IDP report form goes into the intern's Council record. Since all registration authorities require certified evidence of employment before admitting a candidate to the examination, this service speeds and simplifies the application process.

When the Council record shows that NCARB education and training requirements have been fully met, the intern is requested to provide the names and addresses of three architects who are knowledgeable about his/her abilities and professional conduct. Upon receipt of these references, NCARB evaluates the entire Council record and transmits a complete copy to the registration board in the jurisdiction where the application for admission to the examination is being made. If the NCARB requirements have been fulfilled, the Council record includes NCARB's recommendation that the applicant be admitted. The board reviews the transmittal from NCARB and makes the final decision on admittance. A fee is charged by NCARB for each transmittal of a Council record.

After an intern-architect has passed the examination and received registration, the Council record can be considered for NCARB certification. Upon request, NCARB will update the Council record with examination grades from the appropriate board and current employment information.

NCARB then conducts a final review and, if all conditions for certification are satisfied, the certification fee is requested and certification is issued upon receipt. NCARB certification is the vehicle through which reciprocal registration may be obtained with other boards. See the IDP Training Guidelines for fee schedules and further information on NCARB services and requirements.

In summary, the Guide explains how the architectural registration process generally works. It describes tasks that may be evaluated as qualifying experience towards architectural registration. You have to want to become registered; you have to plan, in cooperation with your supervisor, how you can obtain qualifying work experience under the supervision of a registered architect. Registration benefits not only you but the Service as well. We encourage your supervisor to look favorably upon creative options for obtaining qualifying experience. Options will have to be worked out on a case-by-case basis. Regional Historical Architects, the Chief Historical Architect, and the Chief, Preservation Assistance Division are available to provide advice and counsel in developing creative possibilities. Good luck.

IDP Training Synopsis

Category A:
Design and Construction Documents

1. Programming-Client Contact

Programming is the process of setting forth in writing the owner's requirements for a given project. Steps in this process include establishing goals; considering a budget; collecting, organizing and analyzing data; isolating and developing concepts; and determining needs in general. The AIA Owner-Architect Agreements presume that the owner will furnish the program and that any involvement of the architect in writing the program will be an additional service not covered in the basic agreement. However, many owners are employing the architect to assist them in this effort. The project will also be affected by the mortgage lender, public officials involved in health, welfare and safety, future tenants, and increasingly, the people who will work in the built environment. Their input at the programming stage is essential in order to maintain an orderly design process.

Possible Intern-Architect Activities
10 Value Units Required
(One Value Unit = 8 hours)

a. Participate in office conferences with park management regarding programming; periodic reviews and formal presentations, and assist in preparing minutes or report for future reference.

b. Assist with presentations at hearings, and at meetings with Service officials, other government agencies and the public.

c. Take part in visits to existing similar projects and participate in interviews with the owners/managers and consultants of these projects.

d. Assist in preparing the summary and evaluation of data and requirements obtained from all sources. The summary is the basis for the final written program and task directive explaining the scope of services.

e. Research current literature pertaining to architectural programming.

2. Site and Environmental Analysis

Site analysis includes land planning, urban design and environmental evaluation. Land planning and urban design are concerned with relationships to surrounding areas and involve consideration of the physical, economic and social impact of proposed land use on the environment, ecology, traffic and population patterns. Government agencies frequently require documentation on the results construction will have on its surroundings (i.e. environmental impact studies). Decisions relating to site analysis must involve the selection, organization and evaluation of pertinent data that will lead to a resolution of the owner's program while conforming to legal requirements.

Possible Intern-Architect Activities
10 Value Units Required

a. Assist in analyzing several sites and historic buildings to assess the feasibility of their use for a proposed function.

b. Help to analyze the feasibility of using a specific site and historic building for the project.

c. Assist in the analysis of the impact of specific land and historic building use and location for a report and consider Section 106 compliance requirements.

d. Assist in the formulation of the most appropriate land use strategy to achieve a desired environmental impact.

e. Research site restrictions such as zoning, easements, utilities, etc.

f. Participate in public hearings about land use issues and prepare reports for future reference.

3. Schematic Design

From the owner-approved program, the architect develops alternative solutions to satisfy technical and aesthetic requirements. Preferred schemes are presented until owner and architect can agree on one.

Possible Intern-Architect Activities
15 Value Units Required

a. Participate in the development and preparation of preliminary design concepts to determine the spatial relationships that best satisfy park management's program and that are sensitive to the building's historic character.

b. Participate in the development and coordination of program requirements with consultants.

c. Assist in the preparation of presentation drawings and models.

d. Assist in the analysis and selection of engineering systems.

e. Participate in design review and approval meetings with park management, user groups, etc.

4. Building Cost Analysis

An important responsibility of the architect is to evaluate the probable project construction cost. Accurate estimates are crucial to the client. They influence decisions involving basic design, selection of building products and systems and construction scheduling. Long-term maintenance, as well as tax impact of material and system selection (value engineering), are additional factors which bear on development of the project. For their own preliminary analysis, most architects use computations based on area and/or volume. Such methods require a limited amount of experience to adjust the unit cost to special conditions of the project. Estimates of cost provided later in the design process are frequently made on the basis of labor and material requirements (quantity surveys), a method which requires a more specialized knowledge of construction costs.

Possible Intern-Architect Activities
10 Value Units Required

a. Calculate the area and volume of a project in accordance with AIA Document D101 "Architectural Area and Volume of Buildings."

b. Make a simplified quantity take-off of selected materials and prepare comparative cost analyses.

c. Assist in the preparation of cost estimates of each stage of a project.

d. Review various references and texts utilized in cost estimating.

e. Assist in the preparation of cost analyses for current projects, using a variety of indices (cost/square foot, cost/cubic foot, unit use, etc.)

f. Conduct a survey of current costs per square foot of various types of projects, using local Dodge Reports, Builder's Exchange reports, historical records of the Service, etc.

5. Code Research

Building inspectors as well as officials in zoning, environmental and other agencies relating to the health, welfare and safety of the public, oversee the enforcement of federal, state and local regulations related to building construction. The codes promulgated by these various agencies have a direct bearing on the total design process and thorough knowledge of all requirements is essential to the satisfactory completion of any project.

Possible Intern-Architect Activities
15 Value Units Required

a. Assist in searching and documenting codes, regulations, ordinances, etc., for one or more specific projects.

b. Study procedures necessary to obtain relief waivers or variances from particular requirements as they relate to a project.

c. Calculate certain variables (i.e. numbers and size of exits, stair dimensions, public toilet rooms, ramps) in satisfaction of code requirements.

d. Determine a project's allowable land coverage as well as maximum areas in compliance with zoning and any other related ordinances.

6. Design Development

Based on the owner-approved schematic design, the architect fixes and details, for the owner's further approval, the size and character of the entire project, including selection of materials and engineering systems.

Possible Intern-Architect Activities
40 Value Units Required

a. Participate in the preparation of detailed development drawings from schematic design documents.

b. Assist in developing various schedules and outline specifications for materials, finishes, fixed equipment, fixtures, construction time and construction cost.

c. Help to coordinate engineering systems proposed for the project.

d. Participate in design review and approval meetings with park management, user groups,etc.

7. Construction Documents

The working drawings phase of construction documents preparation constitutes the major activity in an architect's office. These drawings describe in graphic form all of the essentials of the work to be done: location, size, arrangement and details of the project. As the successful and timely execution of these documents can be equated closely with an office's financial success, architects constantly search for more efficient ways to produce construction documents. No matter what the method of preparation, it is extremely important that the documents be accurate, consistent, complete and understandable. This requires thorough quality control including constant review and crosschecking of all documents. In addition, effective coordination of the drawings of consultants is essential to avoid conflicts among the various trades during construction.

Possible Intern-Architect Activities
155 Value Units Required

a. Work in the preparation of detail drawings, developing technical skills in drafting accuracy, completeness and clarity.

b. Assist in the correlation and coordination of all documents produced by the historical architect and the consultants.

c. Develop a knowledge of professional responsibilities and liabilities arising out of the issuance of construction documents.

d. Participate in the mechanics of reproducing and assembling the finished construction documents.

e. Assist the job captain (or equivalent) in routine administrative/control tasks.

8. Specifications and Materials Research

Well-grounded knowledge of specification writing principles and procedures is essential to the preparation of sound, enforceable specifications. Unless these skills are properly developed, expert knowledge of materials, contracts, and construction procedures cannot be communicated successfully to the ultimate users. A cardinal principle of specification writing requires the architect to understand, very clearly, the relationship between drawings and specifications, and to be able to communicate in a logical, orderly sequence, the requirements of the construction process. Many factors must be considered in the

selection and evaluation of materials or products to be used in a project: appropriateness, durability, aesthetic quality, first cost, maintenance, etc. To avoid future problems, it is extremely important that the architect recognize the ultimate function of each item to be specified. The architect must carefully assess new or untried materials as well as new or unusual applications of familiar items regardless of manufacturer representations, to be certain no hidden deficiencies exist that might create problems for the owner and expose the architect to liability.

Possible Intern-Architect Activities
15 Value Units Required

a. Review construction specifications organization, purpose and format, and assist in writing specifications. Review and analyze bidding forms, insurance aspects, bonding requirements, liens, supplementary and special conditions.

b. Research and evaluate data for products to be specified, including information regarding product availability, cost, code acceptability and manufacturers' reliability. Attend sales presentations in connection with this research.

c. Research industry standards and guidelines for specific classes of products (e.g. masonry cleaners, painting products) as they affect various manufacturers' items being considered for acceptability on a project. Research construction techniques and systems and understand workmanship standards such as poured-in-place concrete, masonry construction, etc.

d. Evaluate the potential for using master specifications in a project specification, including procedures needed to adapt individual sections for this use.

9. Documents Checking and Coordination

Close coordination between drawings and specifications is required when preparing construction documents. The work of each consultant must be reviewed regularly and checked against the architectural drawings as well as the drawings of other consultants to eliminate conflicts. Before final release for construction purposes, the drawings and specifications must be checked and cross-checked for accuracy and compatability.

Possible Intern-Architect Activities
15 Value Units Required

a. Assist in cross-checking products and materials called for in the specifications for consistency with corresponding terminology and descriptions in the working drawings.

b. Check drawings prepared by other draftpersons for accuracy of dimensions, notes, abbreviations, and indications.

c. Assist in developing a schedule of lead time required for proper coordination with other disciplines.

d. Check consultants' drawings with architectural drawings and other consultants' drawings for possible conflicts and interference of plumbing lines, ductwork, electrical fixtures etc.

e. Assist in the final project review for compliance with applicable codes, regulations, etc.

Category B: Construction Administration

10. Bidding and Contract Negotiation

The architect assists in establishing and administering bidding procedures, issuing addenda, evaluating proposed substitutions, reviewing the qualifications of bidders, analyzing bids or negotiated proposals and making recommendations for the selection of the contractor(s).

The construction contract and related documents are the formal instruments which bind the major parties in the construction phase together. They detail the desired product and the services to be provided in its construction, as well as the consideration to be paid for the product and the services.

Possible Intern-Architect Activities
10 Value Units Required

a. Carefully review the bidding/award stages of previous projects. Develop an understanding of problems encountered and how they were resolved.

b. Prepare sample bids using quantity take-offs from the building cost analysis.

c. Assist in the prequalification of bidders.

d. Assist in the receipt, analysis and evaluation of bids, including any alternates.

e. Learn what information and submittals are required prior to issuance of notice to proceed.

f. Assist in evaluating equal product considerations in preparing addenda.

g. Meet with contractors and material suppliers to better understand problems they encounter with bid packages and construction contract documents. Understand the role of the contracting officier during the bidding process.

h. Assist in the preparation and negotiation of construction contracts and become familiar with the conditions of the contract for construction in order to identify the government's, contractor's, owner's, bonding company's and insurer's roles in the administration of the construction phase.

11. Construction Phase --- Office

During the construction phase there are many related tasks which do not directly involve field observations: processing contractors' Applications for Payment, change orders, shop drawings and samples, adjudicating disputes, etc. The architect's handling of these matters will usually have a direct bearing on the smooth functioning of the work in the field. For example, prompt processing of the contractor's Application for Payment, including review of any substantiating data that may be required by the contract documents, helps the contractor maintain an even flow of funds.

Items such as shop drawings, samples and test reports submitted for the architect's review must be acted upon promptly to expedite the construction process. Changes in the work which may affect the time of construction or modify the cost are accomplished by change orders. Interpretations necessary for the proper execution of work must be promptly given in writing even when no change order is required.

Possible Intern-Historical Architect Activities
15 Value Units Required

a. Assist in processing applications for payment.

b. Assist in checking shop drawings, evaluting samples submitted and maintaining records.

c. Assist in evaluating requests for changes, interpretation of documents and preparation of Change Orders.

d. Participate in the resolution of disputes and interpretation of conflicts relating to the contract documents.

e. Participate in the assembly of evidence and preparation of testimony to be used before an arbitration panel or in court.

f. Research the legal responsibilities of the government, contractors and architects by attending seminars and using other supplementary education resources.

g. Participate in the preparation of record documents at project completion.

12. Construction Phase --- Observation

In administering the Construction Contract, the architect's function is to determine if the contractor's work generally conforms to the requirements of the contract documents. To evaluate the quality of materials and workmanship the architect must be thoroughly familiar with all of the provisions of the Construction Contract. Periodic reports on

the stage of completion of scheduled activities are collected and compared to the overall Project Schedule at job site meetings. These meetings facilitate communication between the contract parties and produce a detailed progress record. The architect must determine through observation the Date of Substantial Completion and receive all data, warranties and releases required by the contract documents prior to final inspection and final payment. In addition to these construction-related functions, the architect interprets contract documents when disagreements occur, judging the dispute impartially, even when the owner is involved. Dissatisfaction with the architect's decision can lead to arbitration or the courts.

Possible Intern-Architect Activities
15 Value Units Required

a. Visit the job site and participate in observation of the work in place and materials stored, and prepare field reports of such routine inspections.

b. Review and analyze construction time schedules. Understand the various network methods (e,g, critical path method) potentially available to the contractor.

c. By review of the contract documents and through professional development programs, develop an awareness of the contractual obligations.

d. Attend periodic job-site construction meetings and assist in recording and documenting all actions taken and agreed to at such meetings.

e. Participate in the substantial completion inspection and assist in the punch list verification.

f. Participate in the final acceptance inspection for the government.

Category C: Office Management

13. Office Procedures

Although architecture is a creative profession, current techniques of practice require that the architect's office operate in almost the same manner as a commercial enterprise. Steady income must be generated and expenses carefully budgeted and monitored so that economic stability, essential to a successful practice, can be maintained. Accurate records must be kept for tax purposes and for use in future work. Established office requirements and regulations are essential to maintaining a smooth operation; office practice manuals are a typical tool for dissemination of this information. Profitable use of manpower requires budgeting of time and the development of schedules which are adhered to rigidly. The architect's relationship to the owner is established by contractual agreement. A contract establishes the duties and obligations of the parties. In order for a contract to be enforceable, there must be mutual agreement between competent parties, an acceptable monetary consideration, and it must be for a lawful purpose and accomplishable within an established time frame.

Effective public relations play an essential role in the creation of the architect's image. This is important in bringing new clients and work into the office as well as in attracting superior people for the professional staff. The architect must participate in marketing activities if the practice is to succeed. On the other hand, the architect's marketing activities (unlike those of merchants, manufacturers and others in commerce) are subject to certain professional constraints. The architect must learn marketing techniques which are effective while remaining within legitimate rules of professional conduct.

Possible Intern-Architect Activities
15 Value Units Required

a. Review the process of internal accounting and cost control systems for project operation.

b. Participate in allocation of time to all elements involved in a total project from preliminary design through construction.

c. Review professional service contracts for their structure, content, determination of responsibility and enforcement procedures.

d. Assist in the development of programs to publicize professional services and expertise of National Park Service historic architecture.

e. Assist in developing brochures, interpretive literature and technical publications, exhibits of award entries.

14. Professional Activities

To strengthen the profession's image, the architect must participate in public service programs. The architect must also maintain a supportive role with others involved in the construction industry. The various professional societies and other public service opportunities offer viable means of serving the profession and the community. Meaningful involvement requires participation beyond attendance at regular meetings.

Possible Intern-Historical Architect Activities
10 Value Units Required

a. Participate in the work of professional societies through committee activity.

b. Provide service to the public by contribution of expertise toward environment, planning, historic preservation, zoning, housing and codes.

c. Participate in civic programs and organizations.

Category D: Related Special Activities

Energy Conservation

Computer Applications

Construction Management

Planning

Interior Design

Landscape Architecture

Environmental Engineering

Structural Engineering

Applied Research

Teaching

Historic Preservation

Professional Delineation

Handicapped Accessibility

Others

235 Value Units May be Acquired in one Category or spread throughout the Categories

(No minimum Value Units required)